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**ASME B16.47-2017**  
(Revision of ASME B16.47-2011)

# **Large Diameter Steel Flanges**

**NPS 26 Through NPS 60  
Metric/Inch Standard**

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**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

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**The American Society of  
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

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# CONTENTS

|   |          |
|---|----------|
| Foreword . . . . .  | vi       |
| Committee Roster . . . . .  | vii      |
| Correspondence With the B16 Committee . . . . .   | viii     |
| Summary of Changes . . . . .  | x        |
| List of Changes in Record Number Order . . . . .  | xi       |
| <b>1</b> <b>Scope</b> . . . . .   | <b>1</b> |
| <b>2</b> <b>Pressure–Temperature Ratings</b> . . . . .  | <b>2</b> |
| <b>3</b> <b>Component Size: Nominal Pipe Size</b> . . . . .   | <b>3</b> |
| <b>4</b> <b>Marking</b> . . . . .   | <b>3</b> |
| <b>5</b> <b>Materials</b> . . . . .   | <b>4</b> |
| <b>6</b> <b>Dimensions</b> . . . . .  | <b>5</b> |
| <b>7</b> <b>Tolerances</b> . . . . .  | <b>6</b> |
| <b>8</b> <b>Pressure Testing</b> . . . . .  | <b>7</b> |
| <b>Mandatory Appendices</b>   |          |
| I      Pressure–Temperature Ratings and Dimensional Data for Classes 75, 150, 300, 400, 600, and 900<br>Flanges in U.S. Customary Units . . . . . | 52       |
| II     References . . . . .   | 95       |
| <b>Nonmandatory Appendices</b>  |          |
| A      Methods Used for Establishing Pressure–Temperature Ratings . . . . .   | 97       |
| B      Gaskets (Other Than Ring-Joint) . . . . .  | 101      |
| C      Quality System Program . . . . .   | 103      |
| <b>Figures</b>  |          |
| 1      Welding Ends (Welding Neck Flanges, No Backing Rings) . . . . .  | 7        |
| 2      Welding Ends (Welding Neck Flanges With Backing Rings) . . . . .   | 8        |
| 3      Welding Ends (Welding Neck Flanges) . . . . .  | 9        |
| I-1    Welding Ends (Welding Neck Flanges, No Backing Rings) . . . . .  | 53       |
| I-2    Welding Ends (Welding Neck Flanges With Backing Rings) . . . . .   | 54       |
| I-3    Welding Ends (Welding Neck Flanges) . . . . .  | 55       |
| <b>Tables</b>   |          |
| 1      List of Material Specifications . . . . .  | 10       |
| 2      List of Bolting Specifications (Applicable ASTM Specifications) . . . . .  | 12       |
| 3      Pressure–Temperature Ratings for Group 1.1 Materials . . . . .   | 13       |
| 4      Pressure–Temperature Ratings for Group 1.2 Materials . . . . .   | 14       |
| 5      Pressure–Temperature Ratings for Group 1.3 Materials . . . . .   | 15       |

|     |   |    |
|-----|---|----|
| 6   | Pressure–Temperature Ratings for Group 1.4 Materials . . . . .  | 16 |
| 7   | Pressure–Temperature Ratings for Group 1.5 Materials . . . . .  | 17 |
| 8   | Pressure–Temperature Ratings for Group 1.7 Materials . . . . .  | 18 |
| 9   | Pressure–Temperature Ratings for Group 1.9 Materials . . . . .  | 19 |
| 10  | Pressure–Temperature Ratings for Group 1.10 Materials . . . . . | 20 |
| 11  | Pressure–Temperature Ratings for Group 1.11 Materials . . . . . | 21 |
| 12  | Pressure–Temperature Ratings for Group 1.13 Materials . . . . . | 22 |
| 13  | Pressure–Temperature Ratings for Group 1.14 Materials . . . . . | 23 |
| 14  | Pressure–Temperature Ratings for Group 1.15 Materials . . . . . | 24 |
| 15  | Pressure–Temperature Ratings for Group 1.17 Materials . . . . . | 25 |
| 16  | Pressure–Temperature Ratings for Group 1.18 Materials . . . . . | 26 |
| 17  | Pressure–Temperature Ratings for Group 2.1 Materials . . . . .  | 27 |
| 18  | Pressure–Temperature Ratings for Group 2.2 Materials . . . . .  | 28 |
| 19  | Pressure–Temperature Ratings for Group 2.3 Materials . . . . .  | 29 |
| 20  | Pressure–Temperature Ratings for Group 2.4 Materials . . . . .  | 30 |
| 21  | Pressure–Temperature Ratings for Group 2.5 Materials . . . . .  | 31 |
| 22  | Pressure–Temperature Ratings for Group 2.6 Materials . . . . .  | 32 |
| 23  | Pressure–Temperature Ratings for Group 2.7 Materials . . . . .  | 33 |
| 24  | Pressure–Temperature Ratings for Group 2.8 Materials . . . . .  | 34 |
| 25  | Pressure–Temperature Ratings for Group 2.9 Materials . . . . .  | 35 |
| 26  | Pressure–Temperature Ratings for Group 2.10 Materials . . . . . | 36 |
| 27  | Pressure–Temperature Ratings for Group 2.11 Materials . . . . . | 37 |
| 28  | Pressure–Temperature Ratings for Group 2.12 Materials . . . . . | 38 |
| 29  | Dimensions of Ring-Joint Facings . . . . .                      | 39 |
| 30  | Permissible Imperfections in Flange Facing Finish . . . . .     | 39 |
| 31  | Dimensions of Class 150 Series A Flanges . . . . .              | 40 |
| 32  | Dimensions of Class 300 Series A Flanges . . . . .              | 41 |
| 33  | Dimensions of Class 400 Series A Flanges . . . . .              | 42 |
| 34  | Dimensions of Class 600 Series A Flanges . . . . .              | 43 |
| 35  | Dimensions of Class 900 Series A Flanges . . . . .              | 44 |
| 36  | Dimensions of Class 75 Series B Flanges . . . . .               | 45 |
| 37  | Dimensions of Class 150 Series B Flanges . . . . .              | 46 |
| 38  | Dimensions of Class 300 Series B Flanges . . . . .              | 47 |
| 39  | Dimensions of Class 400 Series B Flanges . . . . .              | 48 |
| 40  | Dimensions of Class 600 Series B Flanges . . . . .              | 49 |
| 41  | Dimensions of Class 900 Series B Flanges . . . . .              | 50 |
| 42  | Flange Bolting Dimensional Recommendations . . . . .            | 51 |
| I-1 | Pressure–Temperature Ratings for Group 1.1 Materials . . . . .  | 56 |
| I-2 | Pressure–Temperature Ratings for Group 1.2 Materials . . . . .  | 57 |
| I-3 | Pressure–Temperature Ratings for Group 1.3 Materials . . . . .  | 58 |
| I-4 | Pressure–Temperature Ratings for Group 1.4 Materials . . . . .  | 59 |
| I-5 | Pressure–Temperature Ratings for Group 1.5 Materials . . . . .  | 60 |
| I-6 | Pressure–Temperature Ratings for Group 1.7 Materials . . . . .  | 61 |
| I-7 | Pressure–Temperature Ratings for Group 1.9 Materials . . . . .  | 62 |
| I-8 | Pressure–Temperature Ratings for Group 1.10 Materials . . . . . | 63 |

|      |   |     |
|------|---|-----|
| I-9  | Pressure–Temperature Ratings for Group 1.11 Materials . . . . . | 64  |
| I-10 | Pressure–Temperature Ratings for Group 1.13 Materials . . . . . | 65  |
| I-11 | Pressure–Temperature Ratings for Group 1.14 Materials . . . . . | 66  |
| I-12 | Pressure–Temperature Ratings for Group 1.15 Materials . . . . . | 67  |
| I-13 | Pressure–Temperature Ratings for Group 1.17 Materials . . . . . | 68  |
| I-14 | Pressure–Temperature Ratings for Group 1.18 Materials . . . . . | 69  |
| I-15 | Pressure–Temperature Ratings for Group 2.1 Materials . . . . .  | 70  |
| I-16 | Pressure–Temperature Ratings for Group 2.2 Materials . . . . .  | 71  |
| I-17 | Pressure–Temperature Ratings for Group 2.3 Materials . . . . .  | 72  |
| I-18 | Pressure–Temperature Ratings for Group 2.4 Materials . . . . .  | 73  |
| I-19 | Pressure–Temperature Ratings for Group 2.5 Materials . . . . .  | 74  |
| I-20 | Pressure–Temperature Ratings for Group 2.6 Materials . . . . .  | 75  |
| I-21 | Pressure–Temperature Ratings for Group 2.7 Materials . . . . .  | 76  |
| I-22 | Pressure–Temperature Ratings for Group 2.8 Materials . . . . .  | 77  |
| I-23 | Pressure–Temperature Ratings for Group 2.9 Materials . . . . .  | 78  |
| I-24 | Pressure–Temperature Ratings for Group 2.10 Materials . . . . . | 79  |
| I-25 | Pressure–Temperature Ratings for Group 2.11 Materials . . . . . | 80  |
| I-26 | Pressure–Temperature Ratings for Group 2.12 Materials . . . . . | 81  |
| I-27 | Dimensions of Ring-Joint Facings . . . . .                      | 82  |
| I-28 | Permissible Imperfections in Flange Facing Finish . . . . .     | 83  |
| I-29 | Dimensions of Class 150 Series A Flanges . . . . .              | 84  |
| I-30 | Dimensions of Class 300 Series A Flanges . . . . .              | 85  |
| I-31 | Dimensions of Class 400 Series A Flanges . . . . .              | 86  |
| I-32 | Dimensions of Class 600 Series A Flanges . . . . .              | 87  |
| I-33 | Dimensions of Class 900 Series A Flanges . . . . .              | 88  |
| I-34 | Dimensions of Class 75 Series B Flanges . . . . .               | 89  |
| I-35 | Dimensions of Class 150 Series B Flanges . . . . .              | 90  |
| I-36 | Dimensions of Class 300 Series B Flanges . . . . .              | 91  |
| I-37 | Dimensions of Class 400 Series B Flanges . . . . .              | 92  |
| I-38 | Dimensions of Class 600 Series B Flanges . . . . .              | 93  |
| I-39 | Dimensions of Class 900 Series B Flanges . . . . .              | 94  |
| A-1  | Rating Ceiling Values in bar . . . . .                          | 99  |
| A-2  | Rating Ceiling Values in psig . . . . .                         | 100 |
| B-1  | Gasket Groups and Typical Materials . . . . .                   | 102 |

# FOREWORD

In November 1980, a task force was appointed within Subcommittee C of the American National Standards (ANSI) B16 Committee to develop a standard for pipe flanges in sizes NPS 26 through NPS 48. Every attempt was made to standardize those dimensions that existed within the industry for the materials covered by ANSI B16.5.

Prompted by suggestions from committee members, the task force was authorized to increase the size range to NPS 60. The first draft was developed in December 1982 to include Class 75 through Class 1500 for the size range NPS 26 through NPS 60. Flange dimensions were based on the Manufacturers Standardization Society, Standard Practice (MSS SP) 44 flanges, except for Class 75 flanges that are ANSI/API 605 flanges.

At the request of the American Petroleum Institute (API), flange dimensions, in accordance with the API Standard 605, were included in the subsequent drafts. Class 1500 flanges were deleted due to a lack of interest in using large-size flanges in that pressure-temperature rating.

The API 605 flanges for Classes 150 and 300 and for sizes NPS 36 and smaller for classes higher than Class 300 are not compatible with the MSS SP-44 flanges. Thus, the MSS SP-44 flanges are designated as Series A flanges, and the API 605 flanges are designated as Series B flanges in this Standard. Materials covered in this Standard are as in ANSI B16.5, except nickel base alloys are excluded. Pressure-temperature ratings are in accordance with ANSI B16.5.

In 1982, American National Standards Committee B16 was reorganized as the American Society of Mechanical Engineers (ASME) B16 Committee operating under procedures accredited by ANSI. Following approval by the Standards Committee and ASME, approval as an American National Standard was given by ANSI on June 12, 1990.

The 1996 Edition allowed flanges marked with more than one material grade or specification, revised flange face finish requirements, revised pressure-temperature ratings for several material groups, added permissible flange facing imperfections, added blind flanges for Series B flanges, and included several other revisions. Following approval by the Standards Committee and ASME, Boiler and Pressure Vessel Committee, ANSI approved the previous edition as an American National Standard on October 3, 1996, with the new designation ASME B16.47-1996.

In 2006, several revisions were made, including use of metric units as primary units, with U.S. Customary units in either parenthetical or separate forms. [Mandatory Appendix I](#) was provided after the main text for convenience to cover ratings and dimensions in U.S. Customary units. Inch dimension bolt holes were retained for flanges manufactured to metric dimensions to avoid fit-up problems. Development of metric dimensions was done to reflect the intended precision of the dimension rather than by numerical conversion. For some materials, pressure-temperature ratings were revised to reflect revisions to material strength properties (tensile and yield) listed in the ASME Boiler and Pressure Vessel Code, Section II. Some materials were assigned to different rating tables in order to minimize changes to ratings for commonly used materials. Following the approvals of the Standards Committee and ASME, approval for the revised edition was granted by the American National Standards Institute on November 6, 2006.

In the 2011 edition, the References section was revised to cover the requirements of material specification editions other than those listed in [Mandatory Appendix III](#). Following approval by the Standards Committee and the ASME Board on PTCS, the 2011 revision was approved as an American National Standard by ANSI on August 17, 2011 with the new designation, ASME B16.47-2011.

In the 2017 edition, pressure-temperature ratings for Group 1.18 materials were revised at 650°C (1,200°F). A reference was made to MSS SP-44 for some classes of flanges made with materials having a high yield strength. A forging requirement was made explicit, and references were updated.

Following approval by the ASME B16 Standards Committee, this edition was approved by ANSI as an American National Standard on March 6, 2017, with the new designation ASME B16.47-2017.



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Secretary, B16 Standards Committee  
The American Society of Mechanical Engineers  
Two Park Avenue  
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<http://go.asme.org/Inquiry>

**Proposing Revisions.** Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

**Proposing a Case.** Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

**Interpretations.** Upon request, the B16 Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B16 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at <http://go.asme.org/InterpretationRequest>. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may e-mail the request to the Secretary of the B16 Standards Committee at [SecretaryB16@asme.org](mailto:SecretaryB16@asme.org), or mail it to the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

|                         |   |
|-------------------------|---|
| Subject:                | Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.   |
| Edition:                | Cite the applicable edition of the Standard for which the interpretation is being requested.  |
| Question:               | Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable. |
| Proposed Reply(ies):    | Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.   |
| Background Information: | Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.                                 |

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

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# ASME B16.47-2017

## SUMMARY OF CHANGES

Following approval by the ASME B16 Committee and ASME, and after public review, ASME B16.47-2017 was approved by the American National Standards Institute on March 6, 2017.

ASME B16.47-2017 includes the following changes identified by a margin note, **(17)**.

| <i>Page</i> | <i>Location</i>         | <i>Change (Record Number)</i>  |
|-------------|-------------------------|--|
| 2           | 1.11                    | Added (13-592)   |
| 4           | 5.1                     | New subpara. (b) added, and subsequent subparas. redesignated (11-544)                 |
| 26          | Table 16                | For 650°C, values in third, fifth, and sixth columns revised (15-2359)                 |
| 51          | Table 42                | (1) For Stud bolts, ASME reference revised (14-2174)<br>(2) Note (1) deleted (14-2174) |
| 69          | Table I-14              | For 1,200°F, values in third, fifth, and sixth columns revised (15-2359)               |
| 95          | Mandatory Appendix II   | References updated   |
| 103         | Nonmandatory Appendix C | Former Mandatory Appendix II redesignated as Nonmandatory Appendix C                   |

# LIST OF CHANGES IN RECORD NUMBER ORDER

| <u>Record Number</u> | <u>Change</u>   |
|----------------------|---|
| 11-544               | Revised <a href="#">para. 5.1</a> to explicitly require forgings to be made near the shape of the finished flange.  |
| 13-592               | Added new <a href="#">para. 1.11</a> to offer guidance for flange material used with high yield strength pipe (40,000 psi) not covered in <a href="#">Table 1</a> .                         |
| 14-2174              | Updated references for Stud bolts in <a href="#">Table 42</a> .   |
| 15-2359              | Updated <a href="#">Table 16</a> , Working Pressure for Classes 300, 600, and 900 at 650°C. Updated <a href="#">Table I-14</a> , Working Pressure for Classes 300, 600, and 900 at 1,200°F. |

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# LARGE DIAMETER STEEL FLANGES

## NPS 26 Through NPS 60

### Metric/Inch Standard

## 1 SCOPE

### 1.1 General

This Standard covers pressure–temperature ratings, materials, dimensions, tolerances, marking, and testing for pipe flanges in sizes NPS 26 through NPS 60. Included are flanges with rating class designations 75, 150, 300, 400, 600, and 900 with requirements given in both SI (Metric) and U.S. Customary units, with diameter of bolts and flange bolt holes expressed in inch units.

This Standard is limited to

- (a) flanges made from cast or forged materials
- (b) blind flanges made from cast, forged, or plate materials (see [Tables 1](#) and [2](#))

Also included in this Standard are requirements and recommendations regarding flange bolting, flange gaskets, and flange joints.

### 1.2 Flange Series

This Standard provides two series of flange dimensions. Series A specifies flange dimensions for general use flanges. Series B specifies flange dimensions for compact flanges that, in most cases, have smaller bolt circle diameters than Series A flanges. These two series of flanges are, in general, not interchangeable. The user should recognize that some flanged valves, equipment bolted between flanges, and flanged equipment may be compatible with only one series of these flanges.

### 1.3 References

Codes, standards, and specifications, containing provisions to the extent referenced herein, constitute requirements of this Standard. These references are listed in [Mandatory Appendix II](#).

### 1.4 Time of Purchase, Manufacture, or Installation

The pressure–temperature ratings in this Standard are applicable upon its publication to all flanges within its scope that otherwise meet its requirement. For unused flanges maintained in inventory, the manufacturer of the flange may certify conformance to this edition, provided that it can be demonstrated that all requirements of this edition have been met. Where such components were installed in accordance with the pressure–temperature ratings of an earlier edition of this

Standard, those ratings are applicable, except as may be governed by the applicable code or regulation.

### 1.5 User Accountability

This Standard cites responsibilities that are to be assumed by the flange user in the areas of, for example

- (a) application
- (b) installation
- (c) system pressure testing
- (d) operation
- (e) material selection

### 1.6 Quality Systems

Requirements relating to the product manufacturer's quality system program are described in [Nonmandatory Appendix C](#).

### 1.7 Relevant Units

This Standard states values in both SI (Metric) and U.S. Customary units. As an exception, diameter of bolts and flange bolt holes are expressed in inch units only. These systems of units are to be regarded separately as standard. Within the text, the U.S. Customary units are shown in parentheses or in separate tables that appear in [Mandatory Appendix I](#). The values stated in each system are not exact equivalents; therefore, it is required that each system of units be used independently of the other. Except for diameter of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard.

### 1.8 Selection of Materials

Criteria for selection of materials suitable for particular fluid service are not within the scope of this Standard.

### 1.9 Convention

For determining conformance with this Standard, the convention for fixing significant digits where limits (maximum and minimum values) are specified shall be as defined in ASTM Practice E29. This requires that an observed or calculated value be rounded off to the nearest unit in the last right-hand digit used for expressing the limit. Decimal values and tolerances do not imply a particular method of measurement.

## 1.10 Denotation

**1.10.1 Pressure Rating Designation.** Class, followed by a dimensionless number, is the designation for pressure–temperature ratings (i.e., Class 75, Class 150, Class 300, Class 400, Class 600, Class 900).

**1.10.2 Size.** NPS, followed by a dimensionless number, is the designation for nominal flange size. NPS is related to the reference nominal diameter, DN, used in international and other standards. For the sizes covered in this Standard, the relationship is  $DN = 25 \times NPS$ .

## (17) 1.11 Similar Flanges

MSS SP-44 covers similar Class 150, 300, 400, 600, and 900 flanges for use with high strength pipe made from materials having yield strength greater than 276 MPa (40,000 psi) resulting in large inside pipe diameter and thinner pipe wall. See [para. 2.7](#).

## 2 PRESSURE–TEMPERATURE RATINGS

### 2.1 General

Pressure–temperature ratings are maximum allowable working gage pressures, in bar units, at the temperatures in degrees Celsius shown in [Tables 3](#) through [28](#) for the applicable material and class designation. [Tables I-1](#) through [I-26](#) of [Mandatory Appendix I](#) lists pressure–temperature ratings using pounds per square inch (psi) units for pressure at the temperature in degrees Fahrenheit. For intermediate temperatures, linear interpolation is permitted. Interpolation between class designations is not permitted.

### 2.2 Flanged Joints

A flanged joint is composed of separate and independent, although interrelated, components: the flanges, the gasket, and the bolting, which are assembled by another influence, the assembler. Proper controls must be exercised in the selection and application for all of these elements to attain a joint that has acceptable leak tightness. Assembly and tightening techniques, such as controlled bolt tightening, are described in ASME PCC-1.

### 2.3 Ratings of Flanged Joints

**2.3.1 Basis.** Pressure–temperature ratings apply to flanged joints that conform to the limitations on bolting in [para. 5.3](#) and on gaskets in [para. 5.4](#), and that are made up in accordance with good practice for alignment and assembly (see [para. 2.2](#)). Use of these ratings for flanged joints not conforming to these limitations is the responsibility of the user.

**2.3.2 Mixed Flanged Joints.** If the two flanges in a flanged joint do not have the same pressure–temperature rating, the rating of the joint at any temperature is the lower of the two flange ratings at that temperature.

### 2.4 Rating Temperature

The temperature shown for a corresponding pressure rating is the temperature of the pressure containing shell of the component. In general, this temperature is the same as that of the contained fluid. Use of a pressure rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user, subject to the requirements of applicable codes and regulations. For any temperature below  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ) the rating shall be no greater than the rating shown for  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ). See also [para. 2.5.3](#).

### 2.5 Temperature Considerations

**2.5.1 General.** Use of flanges at either high or low temperatures shall take into consideration the risk of joint leakage due to forces and moments developed in the connected piping or equipment. Provisions in [paras. 2.5.2](#) and [2.5.3](#) are included as advisory with the aim of lessening these risks.

**2.5.2 High Temperature.** Application at temperatures in the creep range will result in decreasing bolt loads as relaxation of flanges, bolts, and gaskets takes place. Flanged joints subjected to thermal gradients may likewise be subject to decreasing bolt loads. Decreased bolt loads diminish the capacity of the flanged joint to sustain loads effectively without leakage. At temperatures above  $200^{\circ}\text{C}$  ( $400^{\circ}\text{F}$ ) for Classes 75 and 150, and above  $400^{\circ}\text{C}$  ( $750^{\circ}\text{F}$ ) for other class designations, flanged joints may develop leakage problems unless care is taken to avoid imposing severe external loads and/or severe thermal gradients.

**2.5.3 Low Temperature.** Some of the materials listed in [Tables 1](#) and [2](#), notably some carbon steels, may undergo a decrease in ductility when used at low temperatures to such an extent as to be unable to safely resist shock loading, sudden changes of stress, or high stress concentration. Some codes or regulations may require impact testing for applications even where temperatures are higher than  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ). When such requirements apply, it is the responsibility of the user to ensure these requirements are communicated to the manufacturer prior to the time of purchase.

### 2.6 System Pressure Testing

Flanged joints may be subjected to system pressure tests at a pressure of 1.5 times the  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) rating rounded off to the next higher 1 bar (25 psi) increment. Testing at any higher pressure is the responsibility of the



user, taking into account the requirements of the applicable code or regulation.

## 2.7 Welding Neck Flanges

**2.7.1 Maximum Bore Size.** Ratings for welding neck flanges covered by this Standard are based upon their hubs at the welding end having a thickness at least equal to that calculated for pipe having a 276 MPa (40,000 psi) specified minimum yield strength. To ensure adequate flange hub thickness for flange sizes NPS 26 and larger, the bore of a welding neck flange, dimension  $B$  as shown in Figures 1 and 2, shall not exceed  $B_{\max}$  determined as follows:

| Class | $B_{\max}$ |
|-------|------------|
| 75    | 0.9971A    |
| 150   | 0.9942A    |
| 300   | 0.9850A    |
| 400   | 0.9800A    |
| 600   | 0.9700A    |
| 900   | 0.9550A    |

$A$  = tabulated hub diameter, beginning of chamfer as listed in the dimensional tables

$B_{\max}$  = maximum permissible diameter for the bore of a welding neck flange

The resultant units for diameter  $B_{\max}$  are the same as those entered for diameter  $A$ .

**2.7.2 Components of Unequal Strength.** The tabulated ratings for welding neck flanges are independent of components of unequal strength or unequal wall thickness to which they may be attached. For all attachments, the pressure rating of the flange shall not be exceeded.

**2.7.3 Attachment Welds.** Attachment welds should be made in accordance with the applicable code or regulation. See para. 6.4 and Figure 3 for weld end dimensional requirements.

## 2.8 Multiple Material Grades

Materials for flanges may meet the requirements of more than one specification or the requirements of more than one grade of a specification listed in Table 1. In either case, the pressure-temperature ratings for any of these specifications or grades may be used provided that the material is marked in accordance with para. 4.2.8.

## 3 COMPONENT SIZE: NOMINAL PIPE SIZE

As applied in this Standard, the use of the phrase “nominal pipe size,” or the designation NPS followed by a dimensionless number, is for the purpose of pipe or flange end connection size identification. The number is not the same as the flange inside diameter.

## 4 MARKING

### 4.1 General

Except as modified herein, flanges shall be marked as required in MSS SP-25, except as noted in para. 4.2.

### 4.2 Identification Markings

**4.2.1 Name.** The manufacturer’s name or trademark shall be applied.

**4.2.2 Materials.** Materials shall be identified in the following ways:

(a) Cast flanges shall be marked with the ASTM specification,<sup>1</sup> grade identification symbol (letters and numbers), and the melt number or melt identification.

(b) Plate flanges and forged flanges shall be marked with the ASTM specification<sup>1</sup> number and grade identification symbol.

(c) A manufacturer may supplement these mandatory material markings with his trade designation for the material grade, but confusion of symbols shall be avoided.

(d) For flanges manufactured from material that meets the requirements for more than one specification or grade of a specification listed in Table 1, see para. 4.2.8.

**4.2.3 Rating Designation.** The flange shall be marked with the number that corresponds to its pressure rating class designation (i.e., 75, 150, 300, 400, 600, or 900).

**4.2.4 Conformance.** The designation B16 or B16.47 shall be applied to the flange, preferably located adjacent to the class designation, to indicate conformance to this Standard. The use of the prefix “ASME” is optional.

**4.2.5 Temperature.** Temperature markings are not required on flanges. However, if marked, the temperature shall be shown with its corresponding tabulated pressure rating for the material.

**4.2.6 Size.** The NPS identification number shall be marked on flanges.

**4.2.7 Ring-Joint Flange.** The edge (periphery) of each ring-joint flange shall be marked with the letter R and the corresponding ring-groove number.

**4.2.8 Multiple Material Marking.** Material for components that meet the requirements for more than one ASTM specification number or grade of a specification listed in Table 1 may, at the manufacturer’s option, be marked with more than one of the applicable specification numbers or grade symbols. These identification markings shall be placed so as to avoid confusion in identification. The

<sup>1</sup> An ASME Boiler and Pressure Vessel Code, Section II specification number may be substituted for an ASTM specification number provided the requirements of the ASME specifications are identical or more stringent than the ASTM specification for the Grade, Class, or Type of material.

multiple marking shall be in accordance with the guidelines set out in ASME Boiler and Pressure Vessel Code, Section II, Part D, Appendix 7.

## 5 MATERIALS

### (17) 5.1 General

(a) Materials required for flanges are listed in [Table 1](#) with the restriction that plate materials shall be used only for blind flanges. Flanges shall be manufactured as one piece in accordance with the applicable material specification. Assembly of multiple pieces into the finished product by welding or other means is not permitted by this Standard.

(b) Each forged flange shall be finished from a part that is brought as nearly as practicable to the finished shape and size by a compressive plastic hot working operation that consolidates the material to produce an essentially wrought structure, and shall be so processed during the operation as to cause metal flow in the direction most favorable for resisting the stresses encountered in service.

(c) Recommended bolting materials are listed in [Table 2](#) (see [para. 5.3](#)).

(d) Corresponding materials listed in the ASME Boiler and Pressure Vessel Code, Section II may be used provided that the requirements of the ASME specification are identical or more stringent than the ASTM specification for the Grade, Class, or Type of material.

**5.1.1 Application.** Criteria for the selection of materials are not within the scope of this Standard. The possibility of material deterioration in service should be considered by the user. Carbide phase conversion to graphite and excessive oxidation of ferritic materials, susceptibility to intergranular corrosion of austenitic materials, or grain boundary attack of nickel base alloys are among those items requiring attention. A detailed discussion of precautionary considerations can be found in

(a) ASME B31.3, Appendix F

(b) ASME Boiler and Pressure Vessel Code Section II, Part D, Appendix 6

(c) ASME Boiler and Pressure Vessel Code Section III, Division 1, Appendix W

**5.1.2 Responsibility.** When service conditions dictate the implementation of special material requirements [e.g., using a Group 2 material above 538°C (1,000°F)], it is the user's responsibility to so specify to the manufacturer to ensure compliance with metallurgical requirements listed in the notes in [Tables 3](#) through [28](#) ([Tables I-1](#) through [I-26](#)).

**5.1.3 Cast Surfaces.** Cast surfaces of flange pressure boundaries shall be in accordance with MSS SP-55, except that all Type I defects are unacceptable, and

defects in excess of Plates "a" and "b" for Type II through Type XII are unacceptable.

## 5.2 Mechanical Properties

Mechanical properties shall be obtained from test specimens that represent the final heat-treated condition of the material required by the material specification.

## 5.3 Bolting

**5.3.1 General.** Bolting listed in [Table 2](#) is recommended for use with flanges covered by this Standard. Bolting of other material may be used if permitted by the applicable code or government regulation. Bolting materials are subject to the limitations given in [paras. 5.3.2](#) through [5.3.5](#).

**5.3.2 High Strength Bolting.** Bolting materials having allowable stresses not less than those for ASTM A193 Gr. B7 are listed as high strength in [Table 2](#). These and other materials of comparable strength may be used in any flanged joint.

**5.3.3 Intermediate Strength Bolting.** When bolting materials listed as intermediate strength in [Table 2](#) or other bolting of comparable strength are used in a flanged joint, it is recommended that the user verify the ability of the selected bolting to seat the selected gasket and maintain a leak-tight joint under expected operating condition.

**5.3.4 Low Strength Bolting.** Bolting materials having no more than 206 MPa (30,000 psi) specified minimum yield strength are listed as low strength in [Table 2](#). These materials and others of comparable strength are to be used only in Classes 75, 150, and 300 flanged joints, and only with gaskets described in [para. 5.4.2](#). Flanged assemblies using low strength carbon steel bolts should not be used above 200°C (400°F) or below -29°C (-20°F).

**5.3.5 Bolting to Gray Iron Flanges.** The following recommendations are made in recognition of the low ductility of gray iron.

(a) Alignment of flange faces is essential, along with control of assembly bolt torque, so as not to overstress gray iron flanges. Care must also be exercised to ensure that piping loads transmitted to gray iron flanges are controlled, taking into account its lack of ductility, and recognizing that gray iron flanges should not be used where suddenly applied loads such as rapid pressure fluctuation may occur.

(b) Where Class 150 steel flanges are bolted to Class 125 gray iron flanges, the gaskets should be made of [Nonmandatory Appendix B](#), Group No. 1a materials, both flanges should have flat faces, and either of the following:

(1) Low strength bolting within the limitations of para. 5.3.4 should be used with ring gaskets extending to the bolt holes.

(2) Bolting of low (para. 5.3.4), intermediate (para. 5.3.3), or high (para. 5.3.2) strength may be used with full face gaskets extending to the outside diameters of the flanges.

(c) Where Class 300 steel flanges are bolted to Class 250 gray iron flanges, the gaskets should be made of Nonmandatory Appendix B, Group No. Ia materials and either of the following:

(1) Low strength bolting within the limitations of para. 5.3.4 should be used with gaskets extending to the bolt holes and with flanges having either raised or flat faces.

(2) Bolting of low (para. 5.3.4), intermediate (para. 5.3.3), or high (para. 5.3.2) strength may be used with full face gaskets extending to the outside diameters of the flanges and with both the Class 300 steel and Class 250 gray iron flanges having flat faces.

## 5.4 Gaskets

**5.4.1 General.** Ring-joint gasket materials shall conform to ASME B16.20. Materials for other gaskets are described in Nonmandatory Appendix B. The user is responsible for the selection of gasket materials that will withstand the expected bolt loading without injurious crushing, and that are suitable for the service conditions.

**5.4.2 Gaskets for Low Strength Bolting.** If bolting listed as low strength in Table 2 is used, gaskets shown in Nonmandatory Appendix B, Table B-1, Group No. Ia are recommended.

**5.4.3 Gaskets for Class 150 Flanged Joints.** It is recommended that only Nonmandatory Appendix B, Table B-1, Group No. Ia or Ib gaskets be used for Class 150 flanged joints.

**5.4.4 Gaskets for Class 75 Flanged Joints.** It is recommended that only Group No. Ia gaskets, with a gasket factor  $m = 2$  or less, and minimum design seating stress  $y = 1,600$  psi or less, be used. The  $m$  and  $y$  factors are those given in Appendix 2 of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

## 6 DIMENSIONS

### 6.1 Flange Facings

**6.1.1 General.** Classes 75, 150, and 300 flanges are regularly furnished with a 2 mm (0.06 in.) raised face. Classes 400, 600, and 900 flanges are regularly furnished with a 7 mm (0.25 in.) raised face. The thickness of the raised face in all cases is in addition to the minimum flange thickness,  $t_f$ . It is recommended that the Class 75 flanges be used only with a 2 mm (0.06 in.) raised face or flat face.

Dimensions for ring-joint facing are given in Table 29 (Table I-27) for Series A flanges.

**6.1.1.1 Raised Face Flanges.** The raised face thickness shall be in addition to the minimum flange thickness,  $t_f$ .

**6.1.1.2 Ring-Joint Flanges.** The thickness required to form the ring-joint groove (dimension  $E$  in Table 29 and Table I-27) shall be in addition to the minimum flange thickness,  $t_f$ .

**6.1.2 Blind Flanges.** Blind flanges need not be faced in the center if, when this center part is raised, its diameter is at least 25 mm (1 in.) smaller than the mating pipe inside diameter. When the center part is depressed, its diameter shall not be greater than the inside diameter of the mating flange. Machining of the depressed center is not required.

**6.1.3 Flat Face Flanges.** The raised face may be removed by the user from a raised face flange to convert it to a flat face flange.

**6.1.4 Flange Facing Finish.** Flange facing finishes shall be in accordance with paras. 6.1.4.1 and 6.1.4.2, except that other finishes may be furnished by agreement between the user and the manufacturer. The finish of the gasket contact faces shall be judged by visual comparison with  $Ra$  standards (see ASME B46.1) and not by instruments having stylus tracers and electronic amplification.

**6.1.4.1 Ring-Joint.** The side wall surface finish of the gasket groove shall not exceed 1.6  $\mu\text{m}$  (63  $\mu\text{in.}$ ) roughness.

**6.1.4.2 Other Flange Facings.** Either a serrated concentric or serrated spiral finish, having a resultant surface finish from 3.2  $\mu\text{m}$  to 6.3  $\mu\text{m}$  (125  $\mu\text{in.}$  to 250  $\mu\text{in.}$ ) average roughness shall be furnished. The cutting tool employed should have an approximate 1.5 mm (0.06 in.) or larger radius, and there should be from 1.8 grooves/mm through 2.2 grooves/mm (45 grooves/in. through 55 grooves/in.).

**6.1.5 Flange Facing Finish Imperfections.** Imperfections in the flange facing finish shall not exceed the dimensions shown in Table 30 (Table I-28). Adjacent imperfections shall be separated by a distance of at least 4 times the maximum radial projection. A radial projection shall be measured by the difference between an outer radius and an inner radius encompassing the imperfection where the radii are struck from the centerline of the bore. Imperfections less than half the depth of the serrations shall not be considered cause for rejection. Protrusions above the serrations are not permitted.

### 6.2 Flange Bolt Holes

Bolt holes are in multiples of four. Bolt holes shall be equally spaced.

### 6.3 Bolting Bearing Surfaces

Flanges shall have bearing surfaces for bolting that are parallel to the flange face within 1 deg. Back facing or spot facing shall not reduce the flange thickness below the dimensions  $t_f$  given in Tables 31 through 41 (Tables I-29 through I-39). Spot facing or back facing shall be in accordance with MSS SP-9.

### 6.4 Welding End Preparation for Welding Neck Flanges

**6.4.1 Illustrations.** Welding ends are illustrated in Figures 1 through 3 (Figures I-1 through I-3).

**6.4.2 Bores.** Cylindrical bores shown in Figure 1 (Figure I-1) are standard unless specifically ordered to suit the special conditions illustrated in Figures 2 and 3 (Figures I-2 and I-3). See para. 2.7 for maximum bore sizes.

### 6.5 Flange Bolting Dimensions

**6.5.1 Dimensional Standards.** Stud-bolts, threaded at both ends or threaded full length, or bolts may be used in flange joints. Dimensional recommendations for bolts, stud-bolts, and nuts are shown in Table 42. See para. 5.3 for bolting material recommendations.

**6.5.2 Bolting Recommendations.** For flange joints, stud bolts with a nut at each end are recommended for all applications.

### 6.6 Gaskets

**6.6.1 Ring-Joint Gaskets.** Ring-joint gasket dimensions should conform to ASME B16.20.

**6.6.2 Nonmetallic Gaskets.** Nonmetallic gasket dimensions should conform to ASME B16.21.

**6.6.3 Spiral Wound and Double-Jacketed Gaskets.** Spiral wound and double-jacketed corrugated metal gaskets should conform to ASME B16.20.

### 6.7 Hub Dimensions

Any modification to hub dimensions shown in Tables 31 through 41 (Tables I-29 through I-39) shall be by agreement between the purchaser and manufacturer and shall be confirmed by calculations in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Appendix 2. Flanges so modified shall be marked with the material designation of the pipe to which they are to be welded in addition to the marking per para. 4.2.2.

## 7 TOLERANCES

### 7.1 Facings

Required tolerances for various flange facings are as follows:

- (a) outside diameter of raised face,  $\pm 2$  mm ( $\pm 0.08$  in.)
- (b) 2 mm (0.06 in.) raised face,  $\pm 0.5$  mm ( $\pm 0.02$  in.)
- (c) 7 mm (0.25 in.) raised face,  $\pm 2$  mm ( $\pm 0.08$  in.)
- (d) ring-joint groove tolerances are shown in Table 29 (Table I-27)

### 7.2 Flange Thickness

Required tolerances for flange thickness,  $t_f$ , are as follows:

| Flange Thickness, $t_f$                      | Tolerances                                  |
|--|---|
| $t_f \leq 25$ mm (1.0 in.)                   | +3.0 mm, -0.0 mm<br>(+0.12 in., -0.00 in.)  |
| 25 mm (1.0 in.) $< t_f \leq 50$ mm (2.0 in.) | +5.0 mm, -0.0 mm<br>(+0.19 in., -0.00 in.)  |
| 50 mm (2.0 in.) $< t_f \leq 75$ mm (3.0 in.) | +8.0 mm, -0.0 mm<br>(+0.31 in., -0.00 in.)  |
| $t_f > 75$ mm (3.0 in.)                      | +10.0 mm, -0.0 mm<br>(+0.38 in., -0.00 in.) |

The plus tolerance is applicable to bolting bearing surfaces whether as-forged, as-cast, spot-faced, or back-faced. See para. 6.3.

### 7.3 Welding End Flange Ends and Hubs

**7.3.1 Outside Diameter.** The required tolerance for the nominal outside diameter, dimension  $A$ , of Figure 1 (Figure I-1), of welding ends of welding neck flanges is +5.0 mm, -2.0 mm (+0.19 in., -0.06 in.).

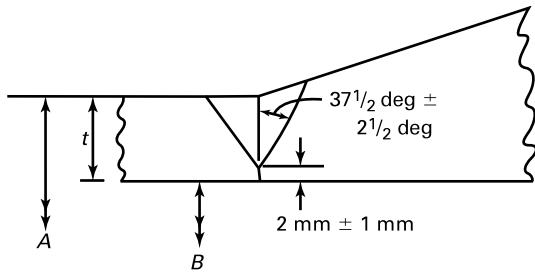
**7.3.2 Inside Diameter.** Required tolerances for the nominal inside diameter, dimension  $B$ , of Figures 1 and 2 (Figures I-1 and I-2), of welding ends of welding neck flanges are as follows:

- (a) for Figure 1: +3.0 mm, -2.0 mm (+0.12 in., -0.06 in.)
- (b) for Figure 2: +0.0 mm, -2.0 mm (+0.00 in., -0.06 in.)

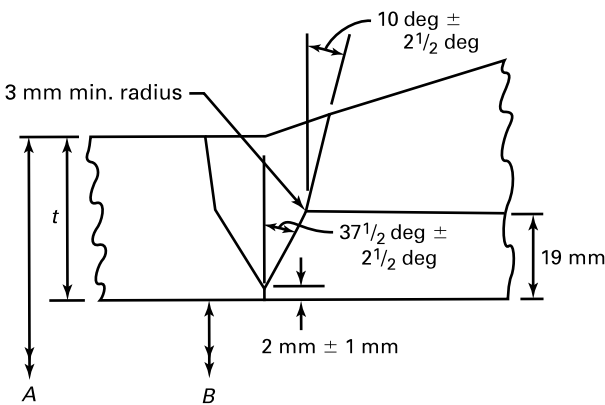
**7.3.3 Backing Ring Contact Surface.** The required tolerance for the bore of the backing ring contact surface of welding neck flanges, dimension  $C$  of Figure 2 (Figure I-2) is +0.25 mm, -0.0 mm (+0.01 in., -0.00 in.).

**7.3.4 Hub Thickness.** Despite the tolerances specified for dimensions  $A$  and  $B$ , the thickness of the hub at the welding end shall not be less than 87.5% of the nominal thickness of the pipe having an undertolerance of 12.5% for the pipe wall thickness to which the flange is to be attached or the minimum wall thickness as specified by the purchaser.

**Figure 1 Welding Ends (Welding Neck Flanges, No Backing Rings)**



**(a) Bevel for Wall Thickness,  $t$   
From 5 mm to 22 mm Inclusive**



**(b) Bevel for Wall Thickness,  $t$   
Greater Than 22 mm**

$A$  = nominal outside diameter of pipe  
 $B$  = nominal inside diameter of pipe  
 $t$  = nominal wall thickness of pipe

**GENERAL NOTES:**

- (a) See paras. 6.4 and 7.4 for details and tolerances.
- (b) See Figure 2 for additional details of welding ends.
- (c) When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined, the additional thickness may be provided on either the inside, or outside, or partially on each side, but the total additional thickness shall not exceed  $\frac{1}{2}$  times the nominal wall thickness of the mating pipe (see Figure 3).

**7.4 Hub Length for Welding Neck Flanges**

The required tolerance for the overall length of hubs for welding neck flanges is +3.0 mm, -5.0 mm (+0.12 in., -0.19 in.).

**7.5 Drilling and Facing**

**7.5.1 Bolt Circle Diameter.** The required tolerance for all bolt circle diameters is  $\pm 1.5$  mm ( $\pm 0.06$  in.).

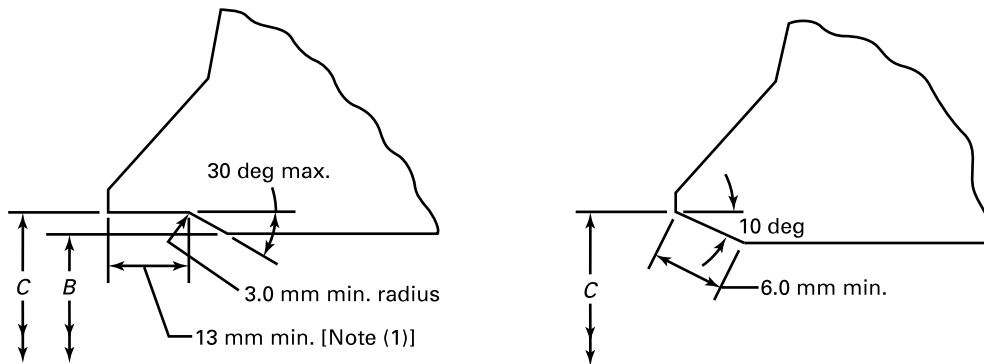
**7.5.2 Bolt Hole to Bolt Hole.** The required tolerance for the center-to-center of adjacent bolt holes is  $\pm 0.8$  mm ( $\pm 0.03$  in.).

**7.5.3 Bolt Circle Concentricity.** The required tolerance for concentricity between the flange bolt circle diameter and machined facing diameter is 1.5 mm (0.06 in.).

**8 PRESSURE TESTING**

**8.1 Flange Test**

Flanges are not required to be pressure tested.

**Figure 2 Welding Ends (Welding Neck Flanges With Backing Rings)****(a) Inside Contour for Use With Rectangular Backing Ring****(b) Inside Contour for Use With Taper Backing Ring**

$A$  = nominal outside diameter of welding end

$B$  = nominal inside diameter of pipe

$$= A - 2t$$

$C$  =  $A - 0.79 \text{ mm} - 1.75t - 0.25 \text{ mm}$

$t$  = nominal wall thickness of pipe

$1.75t$  =  $87\frac{1}{2}\%$  of nominal wall multiplied by two to convert into terms of diameter

0.25 mm = plus tolerance on diameter  $C$  (see [para 7.4.3](#))

0.79 mm = minus tolerance on O.D. of pipe

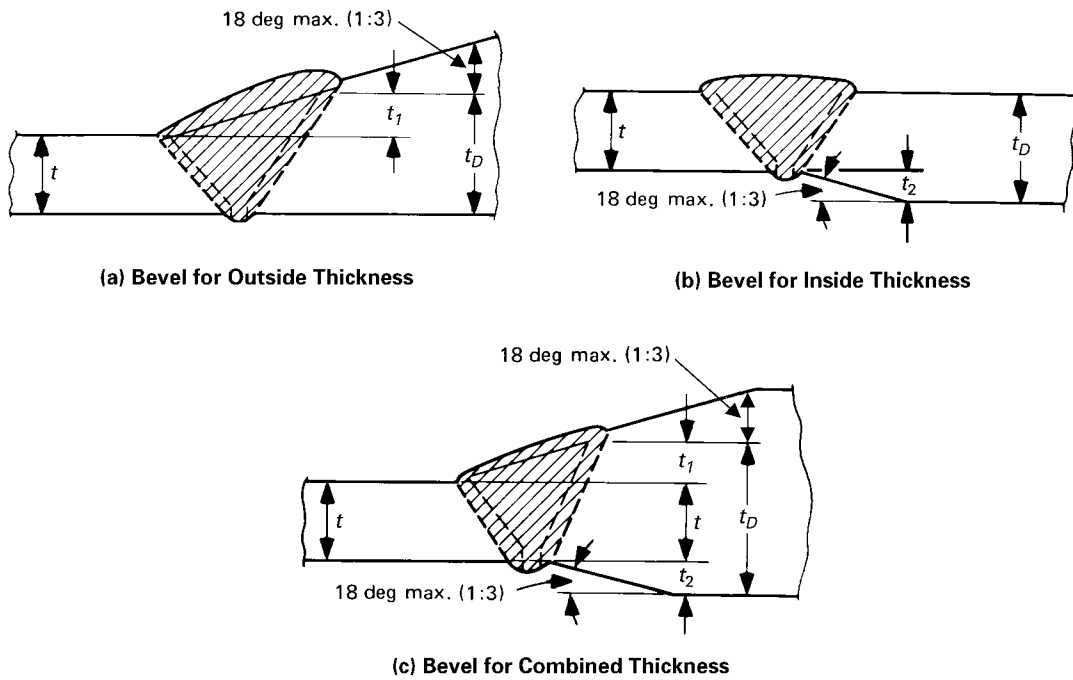
**GENERAL NOTES:**

(a) See [paras. 6.4](#) and [7.4](#) for details and tolerances.

(b) See [Figure 1](#) for welding and details of welding neck flanges.

NOTE: (1) 13 mm depth based on the use of a 19 mm wide backing ring.

**Figure 3 Welding Ends (Welding Neck Flanges)**



**GENERAL NOTES:**

- (a) Neither  $t_1$ ,  $t_2$ , nor their sum ( $t_1 + t_2$ ) shall exceed  $0.5t$ .
- (b) When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal  $t$  times the ratio of minimum specified yield strength of the pipe to the minimum specified yield strength of the flange.
- (c) Welding shall be in accordance with the applicable code.
- (d) Additional thickness for welding to higher strength pipe.

Table 1 List of Material Specifications

| Material Group | Nominal Designation   | Applicable ASTM Specifications |               |                   |
|----------------|---|--------------------------------|---------------|-------------------|
|                |   | Forgings                       | Castings      | Plates            |
| 1.1            | C-Si  | A105                           | A216 Gr. WCB  | A515 Gr. 70       |
| 1.1            | C-Mn-Si   | A350 Gr. LF2                   | ...           | A516 Gr. 70       |
| 1.1            | C-Mn-Si   | ...                            | ...           | A537 Cl. 1        |
| 1.1            | C-Mn-Si-V   | A350 Gr. LF6 Cl. 1             | ...           | ...               |
| 1.1            | 3 <sup>1</sup> / <sub>2</sub> Ni                                    | A350 Gr. LF3                   | ...           | ...               |
| 1.2            | C-Mn-Si   | ...                            | A216 Gr. WCC  | ...               |
| 1.2            | C-Mn-Si   | ...                            | A352 Gr. LCC  | ...               |
| 1.2            | C-Mn-Si-V   | A350 Gr. LF6 Cl. 2             | ...           | ...               |
| 1.2            | 2 <sup>1</sup> / <sub>2</sub> Ni                                    | ...                            | A352 Gr. LC2  | A203 Gr. B        |
| 1.2            | 3 <sup>1</sup> / <sub>2</sub> Ni                                    | ...                            | A352 Gr. LC3  | A203 Gr. E        |
| 1.3            | C-Si  | ...                            | A352 Gr. LCB  | A515 Gr. 65       |
| 1.3            | C-Mn-Si   | ...                            | ...           | A516 Gr. 65       |
| 1.3            | 2 <sup>1</sup> / <sub>2</sub> Ni                                    | ...                            | ...           | A203 Gr. A        |
| 1.3            | 3 <sup>1</sup> / <sub>2</sub> Ni                                    | ...                            | ...           | A203 Gr. D        |
| 1.3            | C- <sup>1</sup> / <sub>2</sub> Mo                                   | ...                            | A217 Gr. WC1  | ...               |
| 1.3            | C- <sup>1</sup> / <sub>2</sub> Mo                                   | ...                            | A352 Gr. LC1  | ...               |
| 1.4            | C-Si  | ...                            | ...           | A515 Gr. 60       |
| 1.4            | C-Mn-Si   | A350 Gr. LF1 Cl. 1             | ...           | A516 Gr. 60       |
| 1.5            | C- <sup>1</sup> / <sub>2</sub> Mo                                   | A182 Gr. F1                    | ...           | A204 Gr. A        |
| 1.5            | C- <sup>1</sup> / <sub>2</sub> Mo                                   | ...                            | ...           | A204 Gr. B        |
| 1.7            | <sup>1</sup> / <sub>2</sub> Cr- <sup>1</sup> / <sub>2</sub> Mo      | A182 Gr. F2                    | ...           | ...               |
| 1.7            | Ni- <sup>1</sup> / <sub>2</sub> Cr- <sup>1</sup> / <sub>2</sub> Mo  | ...                            | A217 Gr. WC4  | ...               |
| 1.7            | <sup>3</sup> / <sub>4</sub> Ni- <sup>3</sup> / <sub>4</sub> Cr-1Mo  | ...                            | A217 Gr. WC5  | ...               |
| 1.9            | 1 <sup>1</sup> / <sub>4</sub> Cr- <sup>1</sup> / <sub>2</sub> Mo    | ...                            | A217 Gr. WC6  | ...               |
| 1.9            | 1 <sup>1</sup> / <sub>4</sub> Cr- <sup>1</sup> / <sub>2</sub> Mo-Si | A182 Gr. F11 Cl. 2             | ...           | A387 Gr. 11 Cl. 2 |
| 1.10           | 2 <sup>1</sup> / <sub>4</sub> Cr-1Mo                                | A182 Gr. F22 Cl. 3             | A217 Gr. WC9  | A387 Gr. 22 Cl. 2 |
| 1.11           | C- <sup>1</sup> / <sub>2</sub> Mo                                   | ...                            | ...           | A240 Gr. C        |
| 1.13           | 5Cr- <sup>1</sup> / <sub>2</sub> Mo                                 | A182 Gr. F5a                   | A217 Gr. C5   | ...               |
| 1.14           | 9Cr-1Mo   | A182 Gr. F9                    | A217 Gr. C12  | ...               |
| 1.15           | 9Cr-1Mo-V   | A182 Gr. F91                   | A217 Gr. C12A | A387 Gr. 91 Cl. 2 |
| 1.17           | 1Cr- <sup>1</sup> / <sub>2</sub> Mo                                 | A182 Gr. F12 Cl. 2             | ...           | ...               |
| 1.17           | 5Cr- <sup>1</sup> / <sub>2</sub> Mo                                 | A182 Gr. F5                    | ...           | ...               |
| 1.18           | 9Cr-2W-V  | A182 Gr. F92                   | ...           | ...               |
| 2.1            | 18Cr-8Ni  | A182 Gr. F304                  | A351 Gr. CF3  | A240 Gr. 304      |
| 2.1            | 18Cr-8Ni  | A182 Gr. F304H                 | A351 Gr. CF8  | A240 Gr. 304H     |
| 2.2            | 16Cr-12Ni-2Mo   | A182 Gr. F316                  | A351 Gr. CF3M | A240 Gr. 316      |
| 2.2            | 16Cr-12Ni-2Mo   | A182 Gr. F316H                 | A351 Gr. CF8M | A240 Gr. 316H     |
| 2.2            | 18Cr-13Ni-3Mo   | A182 Gr. F317                  | ...           | A240 Gr. 317      |
| 2.2            | 19Cr-10Ni-3Mo   | ...                            | A351 Gr. CG8M | ...               |
| 2.3            | 18Cr-8Ni  | A182 Gr. F304L                 | ...           | A240 Gr. 304L     |
| 2.3            | 16Cr-12Ni-2Mo   | A182 Gr. F316L                 | ...           | A240 Gr. 316L     |
| 2.3            | 18Cr-13Ni-3Mo   | A182 Gr. F317L                 | ...           | ...               |
| 2.4            | 18Cr-10Ni-Ti  | A182 Gr. F321                  | ...           | A240 Gr. 321      |



**Table 1 List of Material Specifications (Cont'd)**

| Material Group | Nominal Designation   | Applicable ASTM Specifications |                   |                 |
|----------------|-----------------------|--------------------------------|-------------------|-----------------|
|                |                       | Forgings                       | Castings          | Plates          |
| 2.4            | 18Cr-10Ni-Ti          | A182 Gr. F321H                 | ...               | A240 Gr. 321H   |
| 2.5            | 18Cr-10Ni-Cb          | A182 Gr. F347                  | ...               | A240 Gr. 347    |
| 2.5            | 18Cr-10Ni-Cb          | A182 Gr. F347H                 | ...               | A240 Gr. 347H   |
| 2.5            | 18Cr-10Ni-Cb          | A182 Gr. F348                  | ...               | A240 Gr. 348    |
| 2.5            | 18Cr-10Ni-Cb          | A182 Gr. F348H                 | ...               | A240 Gr. 348H   |
| 2.6            | 23Cr-12Ni             | ...                            | ...               | A240 Gr. 309H   |
| 2.7            | 25Cr-20Ni             | A182 Gr. F310                  | ...               | A240 Gr. 310H   |
| 2.8            | 20Cr-18Ni-6Mo         | A182 Gr. F44                   | A351 Gr. CK3MCuN  | A240 Gr. S31254 |
| 2.8            | 22Cr-5Ni-3Mo-N        | A182 Gr. F51                   | ...               | A240 Gr. S31803 |
| 2.8            | 25Cr-7Ni-4Mo-N        | A182 Gr. F53                   | ...               | A240 Gr. S32750 |
| 2.8            | 24Cr-10Ni-4Mo-V       | ...                            | A351 Gr. CE8MN    | ...             |
| 2.8            | 25Cr-5Ni-2Mo-3Cu      | ...                            | A995 Gr. CD4MCu   | ...             |
| 2.8            | 25Cr-7Ni-3.5Mo-W-Cb   | ...                            | A995 Gr. CD3MWCuN | ...             |
| 2.8            | 25Cr-7Ni-3.5Mo-N-Cu-W | A182 Gr. F55                   | ...               | A240 Gr. S32760 |
| 2.9            | 23Cr-12Ni             | ...                            | ...               | A240 Gr. 309S   |
| 2.9            | 25Cr-20Ni             | ...                            | ...               | A240 Gr. 310S   |
| 2.10           | 25Cr-12Ni             | ...                            | A351 Gr. CH8      | ...             |
| 2.10           | 25Cr-12Ni             | ...                            | A351 Gr. CH20     | ...             |
| 2.11           | 18Cr-10Ni-Cb          | ...                            | A351 Gr. CF8C     | ...             |
| 2.12           | 25Cr-20Ni             | ...                            | A351 Gr. CK20     | ...             |

**Table 2 List of Bolting Specifications (Applicable ASTM Specifications)**

| Bolting Materials        |       |                                  |       |                         |       |
|--------------------------|-------|----------------------------------|-------|-------------------------|-------|
| High Strength [Note (1)] |       | Intermediate Strength [Note (2)] |       | Low Strength [Note (3)] |       |
| Spec.-Grade              | Notes | Spec.-Grade                      | Notes | Spec.-Grade             | Notes |
| A193-B7                  | ...   | A193-B5                          | ...   | A193-B8 Cl. 1           | (4)   |
| A193-B16                 | ...   | A193-B6                          | ...   | A193-B8C Cl. 1          | (4)   |
|                          |       | A193-B6X                         | ...   | A193-B8M Cl. 1          | (4)   |
| A320-L7                  | (5)   | A193-B7M                         | ...   | A193-B8T Cl. 1          | (4)   |
| A320-L7A                 | (5)   |                                  |       |                         |       |
| A320-L7B                 | (5)   | A193-B8 Cl. 2, 2B                | (6)   | A193-B8A                | (4)   |
| A320-L7C                 | (5)   | A193-B8C Cl. 2                   | (6)   | A193-B8CA               | ...   |
| A320-L43                 | (5)   | A193-B8M Cl. 2, 2B, 2C           | (6)   | A193-B8MA               | ...   |
|                          |       | A193-B8T Cl. 2                   | (6)   | A193-B8TA               | (4)   |
| A354-BC                  | ...   |                                  |       |                         |       |
| A354-BD                  | ...   | A320-B8 Cl. 2                    | (6)   | A307-B                  | (7)   |
|                          |       | A320-B8C Cl. 2                   | (6)   |                         |       |
| A540-B21                 | ...   | A320-B8F Cl. 2                   | (6)   | A320-B8 Cl. 1           | (4)   |
| A540-B22                 | ...   | A320-B8M Cl. 2                   | (6)   | A320-B8C Cl. 1          | (4)   |
| A540-B23                 | ...   | A320-B8T Cl. 2                   | (6)   | A320-B8M Cl. 1          | (4)   |
| A540-B24                 | ...   |                                  |       | A320-B8T Cl. 1          | (4)   |
|                          |       | A449                             | (8)   |                         |       |
|                          |       | A453-651                         | (9)   |                         |       |
|                          |       | A453-660                         | (9)   |                         |       |

## GENERAL NOTES:

- (a) Bolting material shall not be used beyond temperature limits specified in the governing code.  
 (b) ASME Boiler and Pressure Vessel Code, Section II materials, which also meet the requirements of the listed ASTM specifications, may also be used.  
 (c) Repair welding of bolting material is prohibited.

## NOTES:

- (1) These bolting materials may be used with all listed materials and gaskets. See [para. 5.3.2](#).  
 (2) These bolting materials may be used with all listed materials and gaskets, provided it has been verified that a sealed joint can be maintained under rated working pressure and temperature. See [para. 5.3.3](#).  
 (3) These bolting materials may be used with all listed materials, but are limited to Classes 75, 150, and 300 joints. See [para. 5.3.4](#). See [para. 5.4](#) for recommended gasket practices.  
 (4) This austenitic stainless material has been carbide solution treated but not strain hardened. Use A194 nuts of corresponding material.  
 (5) This ferritic material is intended for low temperature service. Use A194 Gr. 4 or Gr. 7 nuts.  
 (6) This austenitic stainless material has been carbide solution treated and strain hardened. Use A194 nuts of corresponding material.  
 (7) This carbon steel fastener shall not be used above 200°C (400°F) or below -29°C (-20°F). See also Note (3). Bolts with drilled or undersized heads shall not be used.  
 (8) Acceptable nuts for use with quenched and tempered bolts are A194 Gr. 2 and Gr. 2H. Mechanical property requirements for studs shall be the same as those for bolts.  
 (9) This special alloy is intended for high temperature service with austenitic stainless steel.

**Table 3 Pressure–Temperature Ratings for Group 1.1 Materials**

| Nominal Designation                     | Forgings                      |      | Castings                |      | Plates                       |       |
|---|-------------------------------|------|-------------------------|------|------------------------------|-------|
|   |                               |      |                         |      |                              |       |
| C–Si                                    | A105 [Note (1)]               |      | A216 Gr. WCB [Note (1)] |      | A515 Gr. 70 [Note (1)]       |       |
| C–Mn–Si                                 | A350 Gr. LF2 [Note (1)]       |      | ...                     |      | A516 Gr. 70 [Notes (1), (2)] |       |
| C–Mn–Si                                 | ...                           |      | ...                     |      | A537 Cl. 1 [Note (3)]        |       |
| C–Mn–Si–V                               | A350 Gr. LF6 Cl. 1 [Note (4)] |      | ...                     |      | ...                          |       |
| 3½Ni                                    | A350 Gr. LF3                  |      | ...                     |      | ...                          |       |
| <b>Working Pressure by Classes, bar</b> |                               |      |                         |      |                              |       |
| Temperature, °C                         | 75                            | 150  | 300                     | 400  | 600                          | 900   |
| –29 to 38                               | 9.8                           | 19.6 | 51.1                    | 68.1 | 102.1                        | 153.2 |
| 50                                      | 9.6                           | 19.2 | 50.1                    | 66.8 | 100.2                        | 150.4 |
| 100                                     | 8.8                           | 17.7 | 46.6                    | 62.1 | 93.2                         | 139.8 |
| 150                                     | 7.9                           | 15.8 | 45.1                    | 60.1 | 90.2                         | 135.2 |
| 200                                     | 6.9                           | 13.8 | 43.8                    | 58.4 | 87.6                         | 131.4 |
| 250                                     | 6.0                           | 12.1 | 41.9                    | 55.9 | 83.9                         | 125.8 |
| 300                                     | 5.1                           | 10.2 | 39.8                    | 53.1 | 79.6                         | 119.5 |
| 325                                     | 4.6                           | 9.3  | 38.7                    | 51.6 | 77.4                         | 116.1 |
| 350                                     | 3.1                           | 8.4  | 37.6                    | 50.1 | 75.1                         | 112.7 |
| 375                                     | ...                           | 7.4  | 36.4                    | 48.5 | 72.7                         | 109.1 |
| 400                                     | ...                           | 6.5  | 34.7                    | 46.3 | 69.4                         | 104.2 |
| 425                                     | ...                           | 5.5  | 28.8                    | 38.4 | 57.5                         | 86.3  |
| 450                                     | ...                           | 4.6  | 23.0                    | 30.7 | 46.0                         | 69.0  |
| 475                                     | ...                           | 3.7  | 17.4                    | 23.2 | 34.9                         | 52.3  |
| 500                                     | ...                           | 2.8  | 11.8                    | 15.7 | 23.5                         | 35.3  |
| 538                                     | ...                           | 1.4  | 5.9                     | 7.9  | 11.8                         | 17.7  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (2) Not to be used over 455°C.
- (3) Not to be used over 370°C.
- (4) Not to be used over 260°C.

**Table 4 Pressure–Temperature Ratings for Group 1.2 Materials**

| Nominal Designation                     | Forgings                      |      | Castings                |      | Plates                |       |
|---|-------------------------------|------|-------------------------|------|-----------------------|-------|
|   |                               |      |                         |      |                       |       |
| C–Mn–Si                                 | ...                           |      | A216 Gr. WCC [Note (1)] |      |                       | ...   |
| C–Mn–Si                                 | ...                           |      | A352 Gr. LCC [Note (2)] |      |                       | ...   |
| C–Mn–Si–V                               | A350 Gr. LF6 Cl. 2 [Note (3)] |      | ...                     |      |                       | ...   |
| 2½Ni                                    | ...                           |      | A352 Gr. LC2            |      | A203 Gr. B [Note (1)] |       |
| 3½Ni                                    | ...                           |      | A352 Gr. LC3 [Note (2)] |      | A203 Gr. E [Note (1)] |       |
| <b>Working Pressure by Classes, bar</b> |                               |      |                         |      |                       |       |
| Temperature, °C                         | 75                            | 150  | 300                     | 400  | 600                   | 900   |
| –29 to 38                               | 9.9                           | 19.8 | 51.7                    | 68.9 | 103.4                 | 155.1 |
| 50                                      | 9.8                           | 19.5 | 51.7                    | 68.9 | 103.4                 | 155.1 |
| 100                                     | 8.8                           | 17.7 | 51.5                    | 68.7 | 103.0                 | 154.6 |
| 150                                     | 7.9                           | 15.8 | 50.2                    | 66.8 | 100.3                 | 150.5 |
| 200                                     | 6.9                           | 13.8 | 48.6                    | 64.8 | 97.2                  | 145.8 |
| 250                                     | 6.0                           | 12.1 | 46.3                    | 61.7 | 92.7                  | 139.0 |
| 300                                     | 5.1                           | 10.2 | 42.9                    | 57.0 | 85.7                  | 128.6 |
| 325                                     | 4.6                           | 9.3  | 41.4                    | 55.0 | 82.6                  | 124.0 |
| 350                                     | 3.1                           | 8.4  | 40.0                    | 53.4 | 80.0                  | 120.1 |
| 375                                     | ...                           | 7.4  | 37.8                    | 50.4 | 75.7                  | 113.5 |
| 400                                     | ...                           | 6.5  | 34.7                    | 46.3 | 69.4                  | 104.2 |
| 425                                     | ...                           | 5.5  | 28.8                    | 38.4 | 57.5                  | 86.3  |
| 450                                     | ...                           | 4.6  | 23.0                    | 30.7 | 46.0                  | 69.0  |
| 475                                     | ...                           | 3.7  | 17.1                    | 22.8 | 34.2                  | 51.3  |
| 500                                     | ...                           | 2.8  | 11.6                    | 15.4 | 23.2                  | 34.7  |
| 538                                     | ...                           | 1.4  | 5.9                     | 7.9  | 11.8                  | 17.7  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (2) Not to be used over 340°C.
- (3) Not to be used over 260°C.

**Table 5 Pressure–Temperature Ratings for Group 1.3 Materials**

| Nominal Designation                     | Forgings |                              | Castings |      | Plates                       |       |
|---|----------|------------------------------|----------|------|------------------------------|-------|
|   |          |                              |          |      |                              |       |
| C–Si                                    | ...      | A352 Gr. LCB [Note (1)]      |          |      | A515 Gr. 65 [Note (2)]       |       |
| C–Mn–Si                                 | ...      |                              | ...      |      | A516 Gr. 65 [Notes (2), (3)] |       |
| C– $\frac{1}{2}$ Mo                     | ...      | A217 Gr. WC1 [Notes (4)–(6)] |          |      | ...                          |       |
| C– $\frac{1}{2}$ Mo                     | ...      | A352 Gr. LC1 [Note (1)]      |          |      | ...                          |       |
| 2 $\frac{1}{2}$ Ni                      | ...      |                              | ...      |      | A203 Gr. A [Note (2)]        |       |
| 3 $\frac{1}{2}$ Ni                      | ...      |                              | ...      |      | A203 Gr. D [Note (2)]        |       |
| <b>Working Pressure by Classes, bar</b> |          |                              |          |      |                              |       |
| Temperature, °C                         | 75       | 150                          | 300      | 400  | 600                          | 900   |
| –29 to 38                               | 9.2      | 18.4                         | 48.0     | 64.0 | 96.0                         | 144.1 |
| 50                                      | 9.1      | 18.2                         | 47.5     | 63.3 | 94.9                         | 142.4 |
| 100                                     | 8.7      | 17.4                         | 45.3     | 60.5 | 90.7                         | 136.0 |
| 150                                     | 7.9      | 15.8                         | 43.9     | 58.6 | 87.9                         | 131.8 |
| 200                                     | 6.9      | 13.8                         | 42.5     | 56.7 | 85.1                         | 127.6 |
| 250                                     | 6.0      | 12.1                         | 40.8     | 54.4 | 81.6                         | 122.3 |
| 300                                     | 5.1      | 10.2                         | 38.7     | 51.6 | 77.4                         | 116.1 |
| 325                                     | 4.6      | 9.3                          | 37.6     | 50.1 | 75.2                         | 112.7 |
| 350                                     | 3.1      | 8.4                          | 36.4     | 48.5 | 72.8                         | 109.2 |
| 375                                     | ...      | 7.4                          | 35.0     | 46.6 | 69.9                         | 104.9 |
| 400                                     | ...      | 6.5                          | 32.6     | 43.5 | 65.2                         | 97.9  |
| 425                                     | ...      | 5.5                          | 27.3     | 36.4 | 54.6                         | 81.9  |
| 450                                     | ...      | 4.6                          | 21.6     | 28.8 | 43.2                         | 64.8  |
| 475                                     | ...      | 3.7                          | 15.7     | 20.9 | 31.3                         | 47.0  |
| 500                                     | ...      | 2.8                          | 11.1     | 14.8 | 22.1                         | 33.2  |
| 538                                     | ...      | 1.4                          | 5.9      | 7.9  | 11.8                         | 17.7  |

## NOTES:

- (1) Not to be used over 340°C.
- (2) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (3) Not to be used over 455°C.
- (4) Upon prolonged exposure to temperatures above 465°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.
- (5) Use normalized and tempered material only.
- (6) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 6 Pressure–Temperature Ratings for Group 1.4 Materials**

| Nominal Designation | Forgings                         |      | Castings |      | Plates                       |       |
|---------------------|----------------------------------|------|----------|------|------------------------------|-------|
|                     |                                  |      |          |      |                              |       |
| C–Si                | ...                              |      | ...      |      | A515 Gr. 60 [Note (1)]       |       |
| C–Mn–Si             | A350 Gr. LF1 Cl. 1 [Note (1)]    |      | ...      |      | A516 Gr. 60 [Notes (1), (2)] |       |
|                     | Working Pressure by Classes, bar |      |          |      |                              |       |
| Temperature, °C     | 75                               | 150  | 300      | 400  | 600                          | 900   |
| –29 to 38           | 8.2                              | 16.3 | 42.6     | 56.7 | 85.1                         | 127.7 |
| 50                  | 8.0                              | 16.0 | 41.8     | 55.7 | 83.5                         | 125.3 |
| 100                 | 7.4                              | 14.9 | 38.8     | 51.8 | 77.7                         | 116.5 |
| 150                 | 7.2                              | 14.4 | 37.6     | 50.1 | 75.1                         | 112.7 |
| 200                 | 6.9                              | 13.8 | 36.4     | 48.5 | 72.8                         | 109.2 |
| 250                 | 6.0                              | 12.1 | 34.9     | 46.6 | 69.8                         | 104.7 |
| 300                 | 5.1                              | 10.2 | 33.2     | 44.2 | 66.4                         | 99.5  |
| 325                 | 4.6                              | 9.3  | 32.2     | 43.0 | 64.5                         | 96.7  |
| 350                 | 3.1                              | 8.4  | 31.2     | 41.7 | 62.5                         | 93.7  |
| 375                 | ...                              | 7.4  | 30.4     | 40.5 | 60.7                         | 91.1  |
| 400                 | ...                              | 6.5  | 29.3     | 39.1 | 58.7                         | 88.0  |
| 425                 | ...                              | 5.5  | 25.8     | 34.4 | 51.5                         | 77.3  |
| 450                 | ...                              | 4.6  | 21.4     | 28.5 | 42.7                         | 64.1  |
| 475                 | ...                              | 3.7  | 14.1     | 18.8 | 28.2                         | 42.3  |
| 500                 | ...                              | 2.8  | 10.3     | 13.7 | 20.6                         | 30.9  |
| 538                 | ...                              | 1.4  | 5.9      | 7.9  | 11.8                         | 17.7  |

## NOTES:

(1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.

(2) Not to be used over 455°C.

**Table 7 Pressure–Temperature Ratings for Group 1.5 Materials**

| Nominal Designation              | Forgings               |      | Castings |      | Plates                |       |
|----------------------------------|------------------------|------|----------|------|-----------------------|-------|
|                                  |                        |      |          |      |                       |       |
| C- $\frac{1}{2}$ Mo              | A182 Gr. F1 [Note (1)] |      | ...      |      | A204 Gr. A [Note (1)] |       |
| C- $\frac{1}{2}$ Mo              | ...                    |      | ...      |      | A204 Gr. B [Note (1)] |       |
| Working Pressure by Classes, bar |                        |      |          |      |                       |       |
| Temperature, °C                  | 75                     | 150  | 300      | 400  | 600                   | 900   |
| -29 to 38                        | 9.2                    | 18.4 | 48.0     | 64.0 | 96.0                  | 144.1 |
| 50                               | 9.2                    | 18.4 | 48.0     | 64.0 | 96.0                  | 144.1 |
| 100                              | 8.8                    | 17.7 | 47.9     | 63.9 | 95.9                  | 143.8 |
| 150                              | 7.9                    | 15.8 | 47.3     | 63.1 | 94.7                  | 142.0 |
| 200                              | 6.9                    | 13.8 | 45.8     | 61.1 | 91.6                  | 137.4 |
| 250                              | 6.0                    | 12.1 | 44.5     | 59.3 | 89.0                  | 133.5 |
| 300                              | 5.1                    | 10.2 | 42.9     | 57.0 | 85.7                  | 128.6 |
| 325                              | 4.6                    | 9.3  | 41.4     | 55.0 | 82.6                  | 124.0 |
| 350                              | 3.1                    | 8.4  | 40.3     | 53.6 | 80.4                  | 120.7 |
| 375                              | ...                    | 7.4  | 38.9     | 51.6 | 77.6                  | 116.5 |
| 400                              | ...                    | 6.5  | 36.5     | 48.9 | 73.3                  | 109.8 |
| 425                              | ...                    | 5.5  | 35.2     | 46.5 | 70.0                  | 105.1 |
| 450                              | ...                    | 4.6  | 33.7     | 45.1 | 67.7                  | 101.4 |
| 475                              | ...                    | 3.7  | 31.7     | 42.3 | 63.4                  | 95.1  |
| 500                              | ...                    | 2.8  | 24.1     | 32.1 | 48.1                  | 72.2  |
| 538                              | ...                    | 1.4  | 11.3     | 15.1 | 22.7                  | 34.0  |

NOTE: (1) Upon prolonged exposure to temperatures above 465°C, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.

**Table 8 Pressure–Temperature Ratings for Group 1.7 Materials**

| Nominal Designation                    | Forgings               | Castings                      |      |      |       | Plates |
|--|------------------------|-------------------------------|------|------|-------|--------|
| $\frac{1}{2}$ Cr– $\frac{1}{2}$ Mo     | A182 Gr. F2 [Note (1)] | ...                           |      |      |       | ...    |
| Ni– $\frac{1}{2}$ Cr– $\frac{1}{2}$ Mo | ...                    | A217 Gr. WC4 [Notes (1)–(3)]  |      |      |       | ...    |
| $\frac{3}{4}$ Ni– $\frac{3}{4}$ Cr–1Mo | ...                    | A217 Gr. WC5 [Notes (2), (3)] |      |      |       | ...    |
| Working Pressure by Classes, bar       |                        |                               |      |      |       |        |
| Temperature, °C                        | 75                     | 150                           | 300  | 400  | 600   | 900    |
| –29 to 38                              | 9.9                    | 19.8                          | 51.7 | 68.9 | 103.4 | 155.1  |
| 50                                     | 9.8                    | 19.5                          | 51.7 | 68.9 | 103.4 | 155.1  |
| 100                                    | 8.8                    | 17.7                          | 51.5 | 68.7 | 103.0 | 154.6  |
| 150                                    | 7.9                    | 15.8                          | 50.3 | 66.8 | 100.3 | 150.6  |
| 200                                    | 6.9                    | 13.8                          | 48.6 | 64.8 | 97.2  | 145.8  |
| 250                                    | 6.0                    | 12.1                          | 46.3 | 61.7 | 92.7  | 139.0  |
| 300                                    | 5.1                    | 10.2                          | 42.9 | 57.0 | 85.7  | 128.6  |
| 325                                    | 4.6                    | 9.3                           | 41.4 | 55.0 | 82.6  | 124.0  |
| 350                                    | 3.1                    | 8.4                           | 40.3 | 53.6 | 80.4  | 120.7  |
| 375                                    | ...                    | 7.4                           | 38.9 | 51.6 | 77.6  | 116.5  |
| 400                                    | ...                    | 6.5                           | 36.5 | 48.9 | 73.3  | 109.8  |
| 425                                    | ...                    | 5.5                           | 35.2 | 46.5 | 70.0  | 105.1  |
| 450                                    | ...                    | 4.6                           | 33.7 | 45.1 | 67.7  | 101.4  |
| 475                                    | ...                    | 3.7                           | 31.7 | 42.3 | 63.4  | 95.1   |
| 500                                    | ...                    | 2.8                           | 26.7 | 35.6 | 53.4  | 80.1   |
| 538                                    | ...                    | 1.4                           | 13.9 | 18.6 | 27.9  | 41.8   |
| 550                                    | ...                    | ...                           | 12.6 | 16.8 | 25.2  | 37.8   |
| 575                                    | ...                    | ...                           | 7.2  | 9.6  | 14.4  | 21.5   |

## NOTES:

- (1) Not to be used over 538°C.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.



**Table 9 Pressure–Temperature Ratings for Group 1.9 Materials**

| Nominal Designation              | Forgings                            |      | Castings                           |      | Plates                       |       |
|----------------------------------|-------------------------------------|------|------------------------------------|------|------------------------------|-------|
|                                  |                                     |      |                                    |      |                              |       |
| 1¼Cr–½Mo                         | ...                                 |      | A217 Gr. WC6 [Notes (1), (3), (4)] |      | ...                          |       |
| 1¼Cr–½Mo–Si                      | A182 Gr. F11 Cl. 2 [Notes (1), (2)] |      | ...                                |      | A387 Gr. 11 Cl. 2 [Note (2)] |       |
| Working Pressure by Classes, bar |                                     |      |                                    |      |                              |       |
| Temperature, °C                  | 75                                  | 150  | 300                                | 400  | 600                          | 900   |
| –29 to 38                        | 9.9                                 | 19.8 | 51.7                               | 68.9 | 103.4                        | 155.1 |
| 50                               | 9.8                                 | 19.5 | 51.7                               | 68.9 | 103.4                        | 155.1 |
| 100                              | 8.8                                 | 17.7 | 51.5                               | 68.6 | 103.0                        | 154.4 |
| 150                              | 7.9                                 | 15.8 | 49.7                               | 66.3 | 99.5                         | 149.2 |
| 200                              | 6.9                                 | 13.8 | 48.0                               | 63.9 | 95.9                         | 143.9 |
| 250                              | 6.0                                 | 12.1 | 46.3                               | 61.7 | 92.7                         | 139.0 |
| 300                              | 5.1                                 | 10.2 | 42.9                               | 57.0 | 85.7                         | 128.6 |
| 325                              | 4.6                                 | 9.3  | 41.4                               | 55.0 | 82.6                         | 124.0 |
| 350                              | 3.1                                 | 8.4  | 40.3                               | 53.6 | 80.4                         | 120.7 |
| 375                              | ...                                 | 7.4  | 38.9                               | 51.6 | 77.6                         | 116.5 |
| 400                              | ...                                 | 6.5  | 36.5                               | 48.9 | 73.3                         | 109.8 |
| 425                              | ...                                 | 5.5  | 35.2                               | 46.5 | 70.0                         | 105.1 |
| 450                              | ...                                 | 4.6  | 33.7                               | 45.1 | 67.7                         | 101.4 |
| 475                              | ...                                 | 3.7  | 31.7                               | 42.3 | 63.4                         | 95.1  |
| 500                              | ...                                 | 2.8  | 25.7                               | 34.3 | 51.5                         | 77.2  |
| 538                              | ...                                 | 1.4  | 14.9                               | 19.9 | 29.8                         | 44.7  |
| 550                              | ...                                 | ...  | 12.7                               | 16.9 | 25.4                         | 38.1  |
| 575                              | ...                                 | ...  | 8.8                                | 11.7 | 17.6                         | 26.4  |
| 600                              | ...                                 | ...  | 6.1                                | 8.1  | 12.2                         | 18.3  |
| 625                              | ...                                 | ...  | 4.3                                | 5.7  | 8.5                          | 12.8  |
| 650                              | ...                                 | ...  | 2.8                                | 3.8  | 5.7                          | 8.5   |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 590°C.
- (3) Not to be used over 590°C.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 10 Pressure–Temperature Ratings for Group 1.10 Materials**

| Nominal Designation | Forgings                         |                                    | Castings |                              | Plates |       |
|---------------------|----------------------------------|------------------------------------|----------|------------------------------|--------|-------|
|                     | Working Pressure by Classes, bar |                                    |          |                              |        |       |
| 2¼Cr–1Mo            | A182 Gr. F22 Cl. 3 [Note (1)]    | A217 Gr. WC9 [Notes (2), (3), (4)] |          | A387 Gr. 22 Cl. 2 [Note (1)] |        |       |
| Temperature, °C     | 75                               | 150                                | 300      | 400                          | 600    | 900   |
| –29 to 38           | 9.9                              | 19.8                               | 51.7     | 68.9                         | 103.4  | 155.1 |
| 50                  | 9.8                              | 19.5                               | 51.7     | 68.9                         | 103.4  | 155.1 |
| 100                 | 8.8                              | 17.7                               | 51.5     | 68.7                         | 103.0  | 154.6 |
| 150                 | 7.9                              | 15.8                               | 50.3     | 66.8                         | 100.3  | 150.6 |
| 200                 | 6.9                              | 13.8                               | 48.6     | 64.8                         | 97.2   | 145.8 |
| 250                 | 6.0                              | 12.1                               | 46.3     | 61.7                         | 92.7   | 139.0 |
| 300                 | 5.1                              | 10.2                               | 42.9     | 57.0                         | 85.7   | 128.6 |
| 325                 | 4.6                              | 9.3                                | 41.4     | 55.0                         | 82.6   | 124.0 |
| 350                 | 3.1                              | 8.4                                | 40.3     | 53.6                         | 80.4   | 120.7 |
| 375                 | 0.0                              | 7.4                                | 38.9     | 51.6                         | 77.6   | 116.5 |
| 400                 | ...                              | 6.5                                | 36.5     | 48.9                         | 73.3   | 109.8 |
| 425                 | ...                              | 5.5                                | 35.2     | 46.5                         | 70.0   | 105.1 |
| 450                 | ...                              | 4.6                                | 33.7     | 45.1                         | 67.7   | 101.4 |
| 475                 | ...                              | 3.7                                | 31.7     | 42.3                         | 63.4   | 95.1  |
| 500                 | ...                              | 2.8                                | 28.2     | 37.6                         | 56.5   | 84.7  |
| 538                 | ...                              | 1.4                                | 18.4     | 24.6                         | 36.9   | 55.3  |
| 550                 | ...                              | ...                                | 15.6     | 20.8                         | 31.3   | 46.9  |
| 575                 | ...                              | ...                                | 10.5     | 14.0                         | 21.1   | 31.6  |
| 600                 | ...                              | ...                                | 6.9      | 9.2                          | 13.8   | 20.7  |
| 625                 | ...                              | ...                                | 4.5      | 6.0                          | 8.9    | 13.4  |
| 650                 | ...                              | ...                                | 2.8      | 3.8                          | 5.7    | 8.5   |

## NOTES:

- (1) Permissible, but not recommended for prolonged use above 590°C.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 590°C.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 11 Pressure–Temperature Ratings for Group 1.11 Materials**

| Nominal Designation | Forgings                         |      | Castings |      | Plates |       |
|---------------------|----------------------------------|------|----------|------|--------|-------|
|                     | C- $\frac{1}{2}$ Mo              |      |          |      |        |       |
| Temperature, °C     | Working Pressure by Classes, bar |      |          |      |        |       |
|                     | 75                               | 150  | 300      | 400  | 600    | 900   |
| -29 to 38           | 10.0                             | 20.0 | 51.7     | 68.9 | 103.4  | 155.1 |
| 50                  | 9.8                              | 19.5 | 51.7     | 68.9 | 103.4  | 155.1 |
| 100                 | 8.8                              | 17.7 | 51.5     | 68.7 | 103.0  | 154.6 |
| 150                 | 7.9                              | 15.8 | 50.3     | 66.8 | 100.3  | 150.6 |
| 200                 | 6.9                              | 13.8 | 48.6     | 64.8 | 97.2   | 145.8 |
| 250                 | 6.0                              | 12.1 | 46.3     | 61.7 | 92.7   | 139.0 |
| 300                 | 5.1                              | 10.2 | 42.9     | 57.0 | 85.7   | 128.6 |
| 325                 | 4.6                              | 9.3  | 41.4     | 55.0 | 82.6   | 124.0 |
| 350                 | 3.1                              | 8.4  | 40.3     | 53.6 | 80.4   | 120.7 |
| 375                 | 0.0                              | 7.4  | 38.9     | 51.6 | 77.6   | 116.5 |
| 400                 | ...                              | 6.5  | 36.5     | 48.9 | 73.3   | 109.8 |
| 425                 | ...                              | 5.5  | 35.2     | 46.5 | 70.0   | 105.1 |
| 450                 | ...                              | 4.6  | 33.7     | 45.1 | 67.7   | 101.4 |
| 475                 | ...                              | 3.7  | 31.7     | 42.3 | 63.4   | 95.1  |
| 500                 | ...                              | 2.8  | 23.6     | 31.4 | 47.1   | 70.7  |
| 538                 | ...                              | 1.4  | 11.3     | 15.1 | 22.7   | 34.0  |
| 550                 | ...                              | ...  | 11.3     | 15.1 | 22.7   | 34.0  |
| 575                 | ...                              | ...  | 10.1     | 13.4 | 20.1   | 30.2  |
| 600                 | ...                              | ...  | 7.1      | 9.5  | 14.2   | 21.3  |
| 625                 | ...                              | ...  | 5.3      | 7.1  | 10.6   | 15.9  |
| 650                 | ...                              | ...  | 3.1      | 4.1  | 6.1    | 9.2   |

NOTE: (1) Upon prolonged exposure to temperatures above 465°C, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.

**Table 12 Pressure–Temperature Ratings for Group 1.13 Materials**

| Nominal Designation | Forgings                         |      | Castings                     |      |       | Plates |
|---------------------|----------------------------------|------|------------------------------|------|-------|--------|
|                     | A182 Gr. F5a                     |      | A217 Gr. C5 [Notes (1), (2)] |      |       | ...    |
| Temperature, °C     | Working Pressure by Classes, bar |      |                              |      |       |        |
|                     | 75                               | 150  | 300                          | 400  | 600   | 900    |
| -29 to 38           | 10.0                             | 20.0 | 51.7                         | 68.9 | 103.4 | 155.1  |
| 50                  | 9.8                              | 19.5 | 51.7                         | 68.9 | 103.4 | 155.1  |
| 100                 | 8.8                              | 17.7 | 51.5                         | 68.7 | 103.0 | 154.6  |
| 150                 | 7.9                              | 15.8 | 50.3                         | 66.8 | 100.3 | 150.6  |
| 200                 | 6.9                              | 13.8 | 48.6                         | 64.8 | 97.2  | 145.8  |
| 250                 | 6.0                              | 12.1 | 46.3                         | 61.7 | 92.7  | 139.0  |
| 300                 | 5.1                              | 10.2 | 42.9                         | 57.0 | 85.7  | 128.6  |
| 325                 | 4.6                              | 9.3  | 41.4                         | 55.0 | 82.6  | 124.0  |
| 350                 | 3.1                              | 8.4  | 40.3                         | 53.6 | 80.4  | 120.7  |
| 375                 | 0.0                              | 7.4  | 38.9                         | 51.6 | 77.6  | 116.5  |
| 400                 | ...                              | 6.5  | 36.5                         | 48.9 | 73.3  | 109.8  |
| 425                 | ...                              | 5.5  | 35.2                         | 46.5 | 70.0  | 105.1  |
| 450                 | ...                              | 4.6  | 33.7                         | 45.1 | 67.7  | 101.4  |
| 475                 | ...                              | 3.7  | 27.9                         | 37.1 | 55.7  | 83.6   |
| 500                 | ...                              | 2.8  | 21.4                         | 28.5 | 42.8  | 64.1   |
| 538                 | ...                              | 1.4  | 13.7                         | 18.3 | 27.4  | 41.1   |
| 550                 | ...                              | ...  | 12.0                         | 16.1 | 24.1  | 36.1   |
| 575                 | ...                              | ...  | 8.9                          | 11.8 | 17.8  | 26.7   |
| 600                 | ...                              | ...  | 6.2                          | 8.3  | 12.5  | 18.7   |
| 625                 | ...                              | ...  | 4.0                          | 5.3  | 8.0   | 12.0   |
| 650                 | ...                              | ...  | 2.4                          | 3.2  | 4.7   | 7.1    |

## NOTES:

(1) Use normalized and tempered material only.

(2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 13 Pressure–Temperature Ratings for Group 1.14 Materials**

| Nominal Designation | Forgings                         |             | Castings                      |      |       | Plates |
|---------------------|----------------------------------|-------------|-------------------------------|------|-------|--------|
|                     | 9Cr–1Mo                          | A182 Gr. F9 | A217 Gr. C12 [Notes (1), (2)] |      |       |        |
| Temperature, °C     | Working Pressure by Classes, bar |             |                               |      |       |        |
|                     | 75                               | 150         | 300                           | 400  | 600   | 900    |
| –29 to 38           | 10.0                             | 20.0        | 51.7                          | 68.9 | 103.4 | 155.1  |
| 50                  | 9.8                              | 19.5        | 51.7                          | 68.9 | 103.4 | 155.1  |
| 100                 | 8.8                              | 17.7        | 51.5                          | 68.7 | 103.0 | 154.6  |
| 150                 | 7.9                              | 15.8        | 50.3                          | 66.8 | 100.3 | 150.6  |
| 200                 | 6.9                              | 13.8        | 48.6                          | 64.8 | 97.2  | 145.8  |
| 250                 | 6.0                              | 12.1        | 46.3                          | 61.7 | 92.7  | 139.0  |
| 300                 | 5.1                              | 10.2        | 42.9                          | 57.0 | 85.7  | 128.6  |
| 325                 | 4.6                              | 9.3         | 41.4                          | 55.0 | 82.6  | 124.0  |
| 350                 | 3.1                              | 8.4         | 40.3                          | 53.6 | 80.4  | 120.7  |
| 375                 | ...                              | 7.4         | 38.9                          | 51.6 | 77.6  | 116.5  |
| 400                 | ...                              | 6.5         | 36.5                          | 48.9 | 73.3  | 109.8  |
| 425                 | ...                              | 5.5         | 35.2                          | 46.5 | 70.0  | 105.1  |
| 450                 | ...                              | 4.6         | 33.7                          | 45.1 | 67.7  | 101.4  |
| 475                 | ...                              | 3.7         | 31.7                          | 42.3 | 63.4  | 95.1   |
| 500                 | ...                              | 2.8         | 28.2                          | 37.6 | 56.5  | 84.7   |
| 538                 | ...                              | 1.4         | 17.5                          | 23.3 | 35.0  | 52.5   |
| 550                 | ...                              | ...         | 15.0                          | 20.0 | 30.0  | 45.0   |
| 575                 | ...                              | ...         | 10.5                          | 13.9 | 20.9  | 31.4   |
| 600                 | ...                              | ...         | 7.2                           | 9.6  | 14.4  | 21.5   |
| 625                 | ...                              | ...         | 5.0                           | 6.6  | 9.9   | 14.9   |
| 650                 | ...                              | ...         | 3.5                           | 4.7  | 7.1   | 10.6   |

## NOTES:

(1) Use normalized and tempered material only.

(2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 14 Pressure–Temperature Ratings for Group 1.15 Materials**

| Nominal Designation | Forgings                         |      | Castings                 |      | Plates            |       |
|---------------------|----------------------------------|------|--------------------------|------|-------------------|-------|
|                     | A182 Gr. F91                     |      | A217 Gr. C12A [Note (1)] |      | A387 Gr. 91 Cl. 2 |       |
| Temperature, °C     | Working Pressure by Classes, bar |      |                          |      |                   |       |
|                     | 75                               | 150  | 300                      | 400  | 600               | 900   |
| -29 to 38           | 10.0                             | 20.0 | 51.7                     | 68.9 | 103.4             | 155.1 |
| 50                  | 9.8                              | 19.5 | 51.7                     | 68.9 | 103.4             | 155.1 |
| 100                 | 8.8                              | 17.7 | 51.5                     | 68.7 | 103.0             | 154.6 |
| 150                 | 7.9                              | 15.8 | 50.3                     | 66.8 | 100.3             | 150.6 |
| 200                 | 6.9                              | 13.8 | 48.6                     | 64.8 | 97.2              | 145.8 |
| 250                 | 6.0                              | 12.1 | 46.3                     | 61.7 | 92.7              | 139.0 |
| 300                 | 5.1                              | 10.2 | 42.9                     | 57.0 | 85.7              | 128.6 |
| 325                 | 4.6                              | 9.3  | 41.4                     | 55.0 | 82.6              | 124.0 |
| 350                 | 3.1                              | 8.4  | 40.3                     | 53.6 | 80.4              | 120.7 |
| 375                 | ...                              | 7.4  | 38.9                     | 51.6 | 77.6              | 116.5 |
| 400                 | ...                              | 6.5  | 36.5                     | 48.9 | 73.3              | 109.8 |
| 425                 | ...                              | 5.5  | 35.2                     | 46.5 | 70.0              | 105.1 |
| 450                 | ...                              | 4.6  | 33.7                     | 45.1 | 67.7              | 101.4 |
| 475                 | ...                              | 3.7  | 31.7                     | 42.3 | 63.4              | 95.1  |
| 500                 | ...                              | 2.8  | 28.2                     | 37.6 | 56.5              | 84.7  |
| 538                 | ...                              | 1.4  | 25.2                     | 33.4 | 50.0              | 75.2  |
| 550                 | ...                              | ...  | 25.0                     | 33.3 | 49.8              | 74.8  |
| 575                 | ...                              | ...  | 24.0                     | 31.9 | 47.9              | 71.8  |
| 600                 | ...                              | ...  | 19.5                     | 26.0 | 39.0              | 58.5  |
| 625                 | ...                              | ...  | 14.6                     | 19.5 | 29.2              | 43.8  |
| 650                 | ...                              | ...  | 9.9                      | 13.2 | 19.9              | 29.8  |

NOTE: (1) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table 15 Pressure–Temperature Ratings for Group 1.17 Materials**

| Nominal Designation              | Forgings                            |      | Castings |      |       | Plates |
|----------------------------------|-------------------------------------|------|----------|------|-------|--------|
|                                  |                                     |      |          |      |       |        |
| 1Cr-½Mo                          | A182 Gr. F12 Cl. 2 [Notes (1), (2)] |      |          |      | ...   | ...    |
| 5Cr-½Mo                          | A182 Gr. F5                         |      |          |      | ...   | ...    |
| Working Pressure by Classes, bar |                                     |      |          |      |       |        |
| Temperature, °C                  | 75                                  | 150  | 300      | 400  | 600   | 900    |
| -29 to 38                        | 9.9                                 | 19.8 | 51.7     | 68.9 | 103.4 | 155.1  |
| 50                               | 9.8                                 | 19.5 | 51.5     | 68.7 | 103.0 | 154.5  |
| 100                              | 8.8                                 | 17.7 | 50.4     | 67.3 | 100.9 | 151.3  |
| 150                              | 7.9                                 | 15.8 | 48.2     | 64.2 | 96.4  | 144.5  |
| 200                              | 6.9                                 | 13.8 | 46.3     | 61.7 | 92.5  | 138.8  |
| 250                              | 6.0                                 | 12.1 | 44.8     | 59.8 | 89.6  | 134.5  |
| 300                              | 5.1                                 | 10.2 | 42.9     | 57.0 | 85.7  | 128.6  |
| 325                              | 4.6                                 | 9.3  | 41.4     | 55.0 | 82.6  | 124.0  |
| 350                              | 3.1                                 | 8.4  | 40.3     | 53.6 | 80.4  | 120.7  |
| 375                              | ...                                 | 7.4  | 38.9     | 51.6 | 77.6  | 116.5  |
| 400                              | ...                                 | 6.5  | 36.5     | 48.9 | 73.3  | 109.8  |
| 425                              | ...                                 | 5.5  | 35.2     | 46.5 | 70.0  | 105.1  |
| 450                              | ...                                 | 4.6  | 33.7     | 45.1 | 67.7  | 101.4  |
| 475                              | ...                                 | 3.7  | 27.9     | 37.1 | 55.7  | 83.6   |
| 500                              | ...                                 | 2.8  | 21.4     | 28.5 | 42.8  | 64.1   |
| 538                              | ...                                 | 1.4  | 13.7     | 18.3 | 27.4  | 41.1   |
| 550                              | ...                                 | ...  | 12.0     | 16.1 | 24.1  | 36.1   |
| 575                              | ...                                 | ...  | 8.8      | 11.7 | 17.6  | 26.4   |
| 600                              | ...                                 | ...  | 6.1      | 8.1  | 12.1  | 18.2   |
| 625                              | ...                                 | ...  | 4.0      | 5.3  | 8.0   | 12.0   |
| 650                              | ...                                 | ...  | 2.4      | 3.2  | 4.7   | 7.1    |

## NOTES:

- (1) Use normalized and tempered material only.  
(2) Permissible, but not recommended for prolonged use above 590°C.

(17) **Table 16 Pressure–Temperature Ratings for Group 1.18 Materials**

| Nominal Designation | Forgings                         |      | Castings |      | Plates |       |
|---------------------|----------------------------------|------|----------|------|--------|-------|
|                     | A182 Gr. F92 [Note (1)]          |      | ...      |      | ...    |       |
| Temperature, °C     | Working Pressure by Classes, bar |      |          |      |        |       |
|                     | 75                               | 150  | 300      | 400  | 600    | 900   |
| -29 to 38           | 10.0                             | 20.0 | 51.7     | 68.9 | 103.4  | 155.1 |
| 50                  | 9.8                              | 19.5 | 51.7     | 68.9 | 103.4  | 155.1 |
| 100                 | 8.9                              | 17.7 | 51.5     | 68.7 | 103.0  | 154.6 |
| 150                 | 7.9                              | 15.8 | 50.3     | 66.8 | 100.3  | 150.6 |
| 200                 | 6.9                              | 13.8 | 48.6     | 64.8 | 97.2   | 145.8 |
| 250                 | 6.1                              | 12.1 | 46.3     | 61.7 | 92.7   | 139.0 |
| 300                 | 5.1                              | 10.2 | 42.9     | 57.0 | 85.7   | 128.6 |
| 325                 | 4.7                              | 9.3  | 41.4     | 55.0 | 82.6   | 124.0 |
| 350                 | 4.2                              | 8.4  | 40.3     | 53.6 | 80.4   | 120.7 |
| 375                 | ...                              | 7.4  | 38.9     | 51.6 | 77.6   | 116.5 |
| 400                 | ...                              | 6.5  | 36.5     | 48.9 | 73.3   | 109.8 |
| 425                 | ...                              | 5.5  | 35.2     | 46.5 | 70.0   | 105.1 |
| 450                 | ...                              | 4.6  | 33.7     | 45.1 | 67.7   | 101.4 |
| 475                 | ...                              | 3.7  | 31.7     | 42.3 | 63.4   | 95.1  |
| 500                 | ...                              | 2.8  | 28.2     | 37.6 | 56.5   | 84.7  |
| 538                 | ...                              | 1.4  | 25.2     | 33.4 | 50.0   | 75.2  |
| 550                 | ...                              | ...  | 25.0     | 33.3 | 49.8   | 74.8  |
| 575                 | ...                              | ...  | 24.0     | 31.9 | 47.9   | 71.8  |
| 600                 | ...                              | ...  | 21.6     | 28.6 | 42.9   | 64.2  |
| 625                 | ...                              | ...  | 18.3     | 24.3 | 36.6   | 54.9  |
| 650                 | ...                              | ...  | 13.2     | 18.9 | 26.5   | 39.7  |

NOTE: (1) Applications above 620°C are limited to tubing of maximum outside diameter of 3½ in.



**Table 17 Pressure–Temperature Ratings for Group 2.1 Materials**

| Nominal Designation              | Forgings                 |      | Castings                |      | Plates                  |       |
|----------------------------------|--------------------------|------|-------------------------|------|-------------------------|-------|
|                                  |                          |      |                         |      |                         |       |
| 18Cr–8Ni                         | A182 Gr. F304 [Note (1)] |      | A351 Gr. CF3 [Note (2)] |      | A240 Gr. 304 [Note (1)] |       |
| 18Cr–8Ni                         | A182 Gr. F304H           |      | A351 Gr. CF8 [Note (1)] |      | A240 Gr. 304H           |       |
| Working Pressure by Classes, bar |                          |      |                         |      |                         |       |
| Temperature, °C                  | 75                       | 150  | 300                     | 400  | 600                     | 900   |
| -29 to 38                        | 9.5                      | 19.0 | 49.6                    | 66.2 | 99.3                    | 148.9 |
| 50                               | 9.2                      | 18.3 | 47.8                    | 63.8 | 95.6                    | 143.5 |
| 100                              | 7.8                      | 15.7 | 40.9                    | 54.5 | 81.7                    | 122.6 |
| 150                              | 7.1                      | 14.2 | 37.0                    | 49.3 | 74.0                    | 111.0 |
| 200                              | 6.6                      | 13.2 | 34.5                    | 46.0 | 69.0                    | 103.4 |
| 250                              | 6.0                      | 12.1 | 32.5                    | 43.3 | 65.0                    | 97.5  |
| 300                              | 5.1                      | 10.2 | 30.9                    | 41.2 | 61.8                    | 92.7  |
| 325                              | 4.6                      | 9.3  | 30.2                    | 40.3 | 60.4                    | 90.7  |
| 350                              | 3.1                      | 8.4  | 29.6                    | 39.5 | 59.3                    | 88.9  |
| 375                              | ...                      | 7.4  | 29.0                    | 38.7 | 58.1                    | 87.1  |
| 400                              | ...                      | 6.5  | 28.4                    | 37.9 | 56.9                    | 85.3  |
| 425                              | ...                      | 5.5  | 28.0                    | 37.3 | 56.0                    | 84.0  |
| 450                              | ...                      | 4.6  | 27.4                    | 36.5 | 54.8                    | 82.2  |
| 475                              | ...                      | 3.7  | 26.9                    | 35.9 | 53.9                    | 80.8  |
| 500                              | ...                      | 2.8  | 26.5                    | 35.3 | 53.0                    | 79.5  |
| 538                              | ...                      | 1.4  | 24.4                    | 32.6 | 48.9                    | 73.3  |
| 550                              | ...                      | ...  | 23.6                    | 31.4 | 47.1                    | 70.7  |
| 575                              | ...                      | ...  | 20.8                    | 27.8 | 41.7                    | 62.5  |
| 600                              | ...                      | ...  | 16.9                    | 22.5 | 33.8                    | 50.6  |
| 625                              | ...                      | ...  | 13.8                    | 18.4 | 27.6                    | 41.4  |
| 650                              | ...                      | ...  | 11.3                    | 15.0 | 22.5                    | 33.8  |
| 675                              | ...                      | ...  | 9.3                     | 12.5 | 18.7                    | 28.0  |
| 700                              | ...                      | ...  | 8.0                     | 10.7 | 16.1                    | 24.1  |
| 725                              | ...                      | ...  | 6.8                     | 9.0  | 13.5                    | 20.3  |
| 750                              | ...                      | ...  | 5.8                     | 7.7  | 11.6                    | 17.3  |
| 775                              | ...                      | ...  | 4.6                     | 6.2  | 9.0                     | 13.7  |
| 800                              | ...                      | ...  | 3.5                     | 4.8  | 7.0                     | 10.5  |
| 816                              | ...                      | ...  | 2.8                     | 3.8  | 5.9                     | 8.6   |

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) Not to be used over 425°C.

**Table 18 Pressure–Temperature Ratings for Group 2.2 Materials**

| Nominal Designation              | Forgings                 |      | Castings                 |      | Plates                  |       |
|----------------------------------|--------------------------|------|--------------------------|------|-------------------------|-------|
|                                  |                          |      |                          |      |                         |       |
| 16Cr–12Ni–2Mo                    | A182 Gr. F316 [Note (1)] |      | A351 Gr. CF3M [Note (2)] |      | A240 Gr. 316 [Note (1)] |       |
| 16Cr–12Ni–2Mo                    | A182 Gr. F316H           |      | A351 Gr. CF8M [Note (1)] |      | A240 Gr. 316H           |       |
| 18Cr–13Ni–3Mo                    | A182 Gr. F317 [Note (1)] |      | ...                      |      | A240 Gr. 317 [Note (1)] |       |
| 19Cr–10Ni–3Mo                    | ...                      |      | A351 Gr. CG8M [Note (3)] |      | ...                     |       |
| Working Pressure by Classes, bar |                          |      |                          |      |                         |       |
| Temperature, °C                  | 75                       | 150  | 300                      | 400  | 600                     | 900   |
| -29 to 38                        | 9.5                      | 19.0 | 49.6                     | 66.2 | 99.3                    | 148.9 |
| 50                               | 9.2                      | 18.4 | 48.1                     | 64.2 | 96.2                    | 144.3 |
| 100                              | 8.1                      | 16.2 | 42.2                     | 56.3 | 84.4                    | 126.6 |
| 150                              | 7.4                      | 14.8 | 38.5                     | 51.3 | 77.0                    | 115.5 |
| 200                              | 6.8                      | 13.7 | 35.7                     | 47.6 | 71.3                    | 107.0 |
| 250                              | 6.0                      | 12.1 | 33.4                     | 44.5 | 66.8                    | 100.1 |
| 300                              | 5.1                      | 10.2 | 31.6                     | 42.2 | 63.2                    | 94.9  |
| 325                              | 4.6                      | 9.3  | 30.9                     | 41.2 | 61.8                    | 92.7  |
| 350                              | 3.1                      | 8.4  | 30.3                     | 40.4 | 60.7                    | 91.0  |
| 375                              | ...                      | 7.4  | 29.9                     | 39.8 | 59.8                    | 89.6  |
| 400                              | ...                      | 6.5  | 29.4                     | 39.3 | 58.9                    | 88.3  |
| 425                              | ...                      | 5.5  | 29.1                     | 38.9 | 58.3                    | 87.4  |
| 450                              | ...                      | 4.6  | 28.8                     | 38.5 | 57.7                    | 86.5  |
| 475                              | ...                      | 3.7  | 28.7                     | 38.2 | 57.3                    | 86.0  |
| 500                              | ...                      | 2.8  | 28.2                     | 37.6 | 56.5                    | 84.7  |
| 538                              | ...                      | 1.4  | 25.2                     | 33.4 | 50.0                    | 75.2  |
| 550                              | ...                      | ...  | 25.0                     | 33.3 | 49.8                    | 74.8  |
| 575                              | ...                      | ...  | 24.0                     | 31.9 | 47.9                    | 71.8  |
| 600                              | ...                      | ...  | 19.9                     | 26.5 | 39.8                    | 59.7  |
| 625                              | ...                      | ...  | 15.8                     | 21.1 | 31.6                    | 47.4  |
| 650                              | ...                      | ...  | 12.7                     | 16.9 | 25.3                    | 38.0  |
| 675                              | ...                      | ...  | 10.3                     | 13.8 | 20.6                    | 31.0  |
| 700                              | ...                      | ...  | 8.4                      | 11.2 | 16.8                    | 25.1  |
| 725                              | ...                      | ...  | 7.0                      | 9.3  | 14.0                    | 21.0  |
| 750                              | ...                      | ...  | 5.9                      | 7.8  | 11.7                    | 17.6  |
| 775                              | ...                      | ...  | 4.6                      | 6.2  | 9.0                     | 13.7  |
| 800                              | ...                      | ...  | 3.5                      | 4.8  | 7.0                     | 10.5  |
| 816                              | ...                      | ...  | 2.8                      | 3.8  | 5.9                     | 8.6   |

## NOTES:

(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

(2) Not to be used over 455°C.

(3) Not to be used over 538°C.

**Table 19 Pressure–Temperature Ratings for Group 2.3 Materials**

| Nominal Designation              | Forgings                  | Castings | Plates                   |      |      |       |
|----------------------------------|---------------------------|----------|--------------------------|------|------|-------|
| 18Cr–8Ni                         | A182 Gr. F304L [Note (1)] | ...      | A240 Gr. 304L [Note (1)] |      |      |       |
| 16Cr–12Ni–2Mo                    | A182 Gr. F316L            | ...      | A240 Gr. 316L            |      |      |       |
| 18Cr–13Ni–3Mo                    | A182 Gr. F317L            | ...      | ...                      |      |      |       |
| Working Pressure by Classes, bar |                           |          |                          |      |      |       |
| Temperature, °C                  | 75                        | 150      | 300                      | 400  | 600  | 900   |
| –29 to 38                        | 7.9                       | 15.9     | 41.4                     | 55.2 | 82.7 | 124.1 |
| 50                               | 7.7                       | 15.3     | 40.0                     | 53.4 | 80.0 | 120.1 |
| 100                              | 6.7                       | 13.3     | 34.8                     | 46.4 | 69.6 | 104.4 |
| 150                              | 6.0                       | 12.0     | 31.4                     | 41.9 | 62.8 | 94.2  |
| 200                              | 5.6                       | 11.2     | 29.2                     | 38.9 | 58.3 | 87.5  |
| 250                              | 5.3                       | 10.5     | 27.5                     | 36.6 | 54.9 | 82.4  |
| 300                              | 5.0                       | 10.0     | 26.1                     | 34.8 | 52.1 | 78.2  |
| 325                              | 4.6                       | 9.3      | 25.5                     | 34.0 | 51.0 | 76.4  |
| 350                              | 3.1                       | 8.4      | 25.1                     | 33.4 | 50.1 | 75.2  |
| 375                              | ...                       | 7.4      | 24.8                     | 33.0 | 49.5 | 74.3  |
| 400                              | ...                       | 6.5      | 24.3                     | 32.4 | 48.6 | 72.9  |
| 425                              | ...                       | 5.5      | 23.9                     | 31.8 | 47.7 | 71.6  |
| 450                              | ...                       | 4.6      | 23.4                     | 31.2 | 46.8 | 70.2  |

NOTE: (1) Not to be used over 425°C.

**Table 20 Pressure–Temperature Ratings for Group 2.4 Materials**

| Nominal Designation              | Forgings                  |      | Castings |      | Plates                   |       |
|----------------------------------|---------------------------|------|----------|------|--------------------------|-------|
|                                  |                           |      |          |      |                          |       |
| 18Cr–10Ni–Ti                     | A182 Gr. F321 [Note (1)]  |      | ...      |      | A240 Gr. 321 [Note (1)]  |       |
| 18Cr–10Ni–Ti                     | A182 Gr. F321H [Note (2)] |      | ...      |      | A240 Gr. 321H [Note (2)] |       |
| Working Pressure by Classes, bar |                           |      |          |      |                          |       |
| Temperature, °C                  | 75                        | 150  | 300      | 400  | 600                      | 900   |
| –29 to 38                        | 9.5                       | 19.0 | 49.6     | 66.2 | 99.3                     | 148.9 |
| 50                               | 9.3                       | 18.6 | 48.6     | 64.7 | 97.1                     | 145.7 |
| 100                              | 8.5                       | 17.0 | 44.2     | 59.0 | 88.5                     | 132.7 |
| 150                              | 7.9                       | 15.7 | 41.0     | 54.6 | 82.0                     | 122.9 |
| 200                              | 6.9                       | 13.8 | 38.3     | 51.1 | 76.6                     | 114.9 |
| 250                              | 6.0                       | 12.1 | 36.0     | 48.0 | 72.0                     | 108.1 |
| 300                              | 5.1                       | 10.2 | 34.1     | 45.5 | 68.3                     | 102.4 |
| 325                              | 4.6                       | 9.3  | 33.3     | 44.4 | 66.6                     | 99.9  |
| 350                              | 3.1                       | 8.4  | 32.6     | 43.5 | 65.2                     | 97.8  |
| 375                              | ...                       | 7.4  | 32.0     | 42.7 | 64.1                     | 96.1  |
| 400                              | ...                       | 6.5  | 31.6     | 42.1 | 63.2                     | 94.8  |
| 425                              | ...                       | 6.5  | 31.1     | 41.5 | 62.3                     | 93.4  |
| 450                              | ...                       | 4.6  | 30.8     | 41.1 | 61.7                     | 92.5  |
| 475                              | ...                       | 3.7  | 30.5     | 40.7 | 61.1                     | 91.6  |
| 500                              | ...                       | 2.8  | 28.2     | 37.6 | 56.5                     | 84.7  |
| 538                              | ...                       | 1.4  | 25.2     | 33.4 | 50.0                     | 75.2  |
| 550                              | ...                       | ...  | 25.0     | 33.3 | 49.8                     | 74.8  |
| 575                              | ...                       | ...  | 24.0     | 31.9 | 47.9                     | 71.8  |
| 600                              | ...                       | ...  | 20.3     | 27.0 | 40.5                     | 60.8  |
| 625                              | ...                       | ...  | 15.8     | 21.1 | 31.6                     | 47.4  |
| 650                              | ...                       | ...  | 12.6     | 16.9 | 25.3                     | 37.9  |
| 675                              | ...                       | ...  | 9.9      | 13.2 | 19.8                     | 29.6  |
| 700                              | ...                       | ...  | 7.9      | 10.5 | 15.8                     | 23.7  |
| 725                              | ...                       | ...  | 6.3      | 8.5  | 12.7                     | 19.0  |
| 750                              | ...                       | ...  | 5.0      | 6.7  | 10.0                     | 15.0  |
| 775                              | ...                       | ...  | 4.0      | 5.3  | 8.0                      | 11.9  |
| 800                              | ...                       | ...  | 3.1      | 4.2  | 6.3                      | 9.4   |
| 816                              | ...                       | ...  | 2.6      | 3.5  | 5.2                      | 7.8   |

## NOTES:

(1) Not to be used over 538°C.

(2) At temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1 095°C.

**Table 21 Pressure–Temperature Ratings for Group 2.5 Materials**

| Nominal Designation              | Forgings                  | Castings | Plates                   |      |      |       |
|----------------------------------|---------------------------|----------|--------------------------|------|------|-------|
|                                  |                           |          |                          |      |      |       |
| 18Cr–10Ni–Cb                     | A182 Gr. F347 [Note (1)]  | ...      | A240 Gr. 347 [Note (1)]  |      |      |       |
| 18Cr–10Ni–Cb                     | A182 Gr. F347H [Note (2)] | ...      | A240 Gr. 347H [Note (2)] |      |      |       |
| 18Cr–10Ni–Cb                     | A182 Gr. F348 [Note (1)]  | ...      | A240 Gr. 348 [Note (1)]  |      |      |       |
| 18Cr–10Ni–Cb                     | A182 Gr. F348H [Note (2)] | ...      | A240 Gr. 348H [Note (2)] |      |      |       |
| Working Pressure by Classes, bar |                           |          |                          |      |      |       |
| Temperature, °C                  | 75                        | 150      | 300                      | 400  | 600  | 900   |
| -29 to 38                        | 9.5                       | 19.0     | 49.6                     | 66.2 | 99.3 | 148.9 |
| 50                               | 9.3                       | 18.7     | 48.8                     | 65.0 | 97.5 | 146.3 |
| 100                              | 8.7                       | 17.4     | 45.3                     | 60.4 | 90.6 | 135.9 |
| 150                              | 7.9                       | 15.8     | 42.5                     | 56.6 | 84.9 | 127.4 |
| 200                              | 6.9                       | 13.8     | 39.9                     | 53.3 | 79.9 | 119.8 |
| 250                              | 6.0                       | 12.1     | 37.8                     | 50.4 | 75.6 | 113.4 |
| 300                              | 5.1                       | 10.2     | 36.1                     | 48.1 | 72.2 | 108.3 |
| 325                              | 4.6                       | 9.3      | 35.4                     | 47.1 | 70.7 | 106.1 |
| 350                              | 3.1                       | 8.4      | 34.8                     | 46.3 | 69.5 | 104.3 |
| 375                              | ...                       | 7.4      | 34.2                     | 45.6 | 68.4 | 102.6 |
| 400                              | ...                       | 6.5      | 33.9                     | 45.2 | 67.8 | 101.7 |
| 425                              | ...                       | 5.5      | 33.6                     | 44.8 | 67.2 | 100.8 |
| 450                              | ...                       | 4.6      | 33.5                     | 44.6 | 66.9 | 100.4 |
| 475                              | ...                       | 3.7      | 31.7                     | 42.3 | 63.4 | 95.1  |
| 500                              | ...                       | 2.8      | 28.2                     | 37.6 | 56.5 | 84.7  |
| 538                              | ...                       | 1.4      | 25.2                     | 33.4 | 50.0 | 75.2  |
| 550                              | ...                       | ...      | 25.0                     | 33.3 | 49.8 | 74.8  |
| 575                              | ...                       | ...      | 24.0                     | 31.9 | 47.9 | 71.8  |
| 600                              | ...                       | ...      | 21.6                     | 28.6 | 42.9 | 64.2  |
| 625                              | ...                       | ...      | 18.3                     | 24.3 | 36.6 | 54.9  |
| 650                              | ...                       | ...      | 14.1                     | 18.9 | 28.1 | 42.5  |
| 675                              | ...                       | ...      | 12.4                     | 16.9 | 25.2 | 37.6  |
| 700                              | ...                       | ...      | 10.1                     | 13.4 | 20.0 | 29.8  |
| 725                              | ...                       | ...      | 7.9                      | 10.5 | 15.4 | 23.2  |
| 750                              | ...                       | ...      | 5.9                      | 7.9  | 11.7 | 17.6  |
| 775                              | ...                       | ...      | 4.6                      | 6.2  | 9.0  | 13.7  |
| 800                              | ...                       | ...      | 3.5                      | 4.8  | 7.0  | 10.5  |
| 816                              | ...                       | ...      | 2.8                      | 3.8  | 5.9  | 8.6   |

NOTES:

- (1) Not to be used over 538°C.
- (2) For temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1 095°C.

Table 22 Pressure–Temperature Ratings for Group 2.6 Materials

| Nominal<br>Designation | Forgings                         |      | Castings |      | Plates        |       |
|------------------------|----------------------------------|------|----------|------|---------------|-------|
|                        | Working Pressure by Classes, bar |      |          |      |               |       |
| Temperature, °C        | 75                               | 150  | 300      | 400  | 600           | 900   |
| 23Cr–12Ni              | ...                              | ...  | ...      | ...  | A240 Gr. 309H |       |
| -29 to 38              | 9.5                              | 19.0 | 49.6     | 66.2 | 99.3          | 148.9 |
| 50                     | 9.3                              | 18.5 | 48.3     | 64.4 | 96.6          | 144.9 |
| 100                    | 8.3                              | 16.5 | 43.1     | 57.5 | 86.2          | 129.3 |
| 150                    | 7.7                              | 15.3 | 40.0     | 53.3 | 80.0          | 120.0 |
| 200                    | 6.9                              | 13.8 | 37.8     | 50.3 | 75.5          | 113.3 |
| 250                    | 6.0                              | 12.1 | 36.1     | 48.1 | 72.1          | 108.2 |
| 300                    | 5.1                              | 10.2 | 34.8     | 46.4 | 69.6          | 104.4 |
| 325                    | 4.6                              | 9.3  | 34.2     | 45.7 | 68.5          | 102.7 |
| 350                    | 3.1                              | 8.4  | 33.8     | 45.1 | 67.6          | 101.4 |
| 375                    | ...                              | 7.4  | 33.4     | 44.5 | 66.8          | 100.1 |
| 400                    | ...                              | 6.5  | 33.1     | 44.1 | 66.1          | 99.2  |
| 425                    | ...                              | 5.5  | 32.6     | 43.5 | 65.3          | 97.9  |
| 450                    | ...                              | 4.6  | 32.2     | 42.9 | 64.4          | 96.5  |
| 475                    | ...                              | 3.7  | 31.7     | 42.3 | 63.4          | 95.1  |
| 500                    | ...                              | 2.8  | 28.2     | 37.6 | 56.5          | 84.7  |
| 538                    | ...                              | 1.4  | 25.2     | 33.4 | 50.0          | 75.2  |
| 550                    | ...                              | ...  | 25.0     | 33.3 | 49.8          | 74.8  |
| 575                    | ...                              | ...  | 22.2     | 29.6 | 44.4          | 66.5  |
| 600                    | ...                              | ...  | 16.8     | 22.4 | 33.5          | 50.3  |
| 625                    | ...                              | ...  | 12.5     | 16.7 | 25.0          | 37.5  |
| 650                    | ...                              | ...  | 9.4      | 12.5 | 18.7          | 28.1  |
| 675                    | ...                              | ...  | 7.2      | 9.6  | 14.5          | 21.7  |
| 700                    | ...                              | ...  | 5.5      | 7.3  | 11.0          | 16.5  |
| 725                    | ...                              | ...  | 4.3      | 5.8  | 8.7           | 13.0  |
| 750                    | ...                              | ...  | 3.4      | 4.6  | 6.8           | 10.2  |
| 775                    | ...                              | ...  | 2.7      | 3.6  | 5.4           | 8.1   |
| 800                    | ...                              | ...  | 2.1      | 2.8  | 4.2           | 6.3   |
| 816                    | ...                              | ...  | 1.8      | 2.4  | 3.5           | 5.3   |

**Table 23 Pressure–Temperature Ratings for Group 2.7 Materials**

| Nominal Designation | Forgings                         |      | Castings |      | Plates        |       |
|---------------------|----------------------------------|------|----------|------|---------------|-------|
|                     | A182 Gr. F310 [Notes (1), (2)]   |      | ...      |      | A240 Gr. 310H |       |
| Temperature, °C     | Working Pressure by Classes, bar |      |          |      |               |       |
|                     | 75                               | 150  | 300      | 400  | 600           | 900   |
| -29 to 38           | 9.5                              | 19.0 | 49.6     | 66.2 | 99.3          | 148.9 |
| 50                  | 9.3                              | 18.5 | 48.4     | 64.5 | 96.7          | 145.1 |
| 100                 | 8.3                              | 16.6 | 43.4     | 57.9 | 86.8          | 130.2 |
| 150                 | 7.7                              | 15.3 | 40.0     | 53.3 | 80.0          | 120.0 |
| 200                 | 6.9                              | 13.8 | 37.6     | 50.1 | 75.2          | 112.8 |
| 250                 | 6.0                              | 12.1 | 35.8     | 47.7 | 71.5          | 107.3 |
| 300                 | 5.1                              | 10.2 | 34.5     | 45.9 | 68.9          | 103.4 |
| 325                 | 4.6                              | 9.3  | 33.9     | 45.2 | 67.7          | 101.6 |
| 350                 | 3.1                              | 8.4  | 33.3     | 44.4 | 66.6          | 99.9  |
| 375                 | ...                              | 7.4  | 32.9     | 43.8 | 65.7          | 98.6  |
| 400                 | ...                              | 6.5  | 32.4     | 43.2 | 64.8          | 97.3  |
| 425                 | ...                              | 5.5  | 32.1     | 42.8 | 64.2          | 96.4  |
| 450                 | ...                              | 4.6  | 31.7     | 42.2 | 63.4          | 95.1  |
| 475                 | ...                              | 3.7  | 31.2     | 41.7 | 62.5          | 93.7  |
| 500                 | ...                              | 2.8  | 28.2     | 37.6 | 56.5          | 84.7  |
| 538                 | ...                              | 1.4  | 25.2     | 33.4 | 50.0          | 75.2  |
| 550                 | ...                              | ...  | 25.0     | 33.3 | 49.8          | 74.8  |
| 575                 | ...                              | ...  | 22.2     | 29.6 | 44.4          | 66.5  |
| 600                 | ...                              | ...  | 16.8     | 22.4 | 33.5          | 50.3  |
| 625                 | ...                              | ...  | 12.5     | 16.7 | 25.0          | 37.5  |
| 650                 | ...                              | ...  | 9.4      | 12.5 | 18.7          | 28.1  |
| 675                 | ...                              | ...  | 7.2      | 9.6  | 14.5          | 21.7  |
| 700                 | ...                              | ...  | 5.5      | 7.3  | 11.0          | 16.5  |
| 725                 | ...                              | ...  | 4.3      | 5.8  | 8.7           | 13.0  |
| 750                 | ...                              | ...  | 3.4      | 4.6  | 6.8           | 10.2  |
| 775                 | ...                              | ...  | 2.7      | 3.5  | 5.3           | 8.0   |
| 800                 | ...                              | ...  | 2.1      | 2.8  | 4.1           | 6.2   |
| 816                 | ...                              | ...  | 1.8      | 2.4  | 3.5           | 5.3   |

## NOTES:

(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

(2) Service temperatures of 565°C and above should be used only when assurance is provided that grain size is not finer than ASTM 6.

**Table 24 Pressure–Temperature Ratings for Group 2.8 Materials**

| Nominal Designation                     | Forgings                |      | Castings                     |      | Plates                     |       |
|---|-------------------------|------|------------------------------|------|----------------------------|-------|
|   |                         |      |                              |      |                            |       |
| 20Cr–18Ni–6Mo                           | A182 Gr. F44            |      | A351 Gr. CK3MCuN             |      | A240 Gr. S31254            |       |
| 22Cr–5Ni–3Mo–N                          | A182 Gr. F51 [Note (1)] |      | ...                          |      | A240 Gr. S31803 [Note (1)] |       |
| 25Cr–7Ni–4Mo–N                          | A182 Gr. F53 [Note (1)] |      | ...                          |      | A240 Gr. S32750 [Note (1)] |       |
| 24Cr–10Ni–4Mo–V                         | ...                     |      | A351 Gr. CE8MN [Note (1)]    |      | ...                        |       |
| 25Cr–5Ni–2Mo–3Cu                        | ...                     |      | A995 Gr. CD4MCu [Note (1)]   |      | ...                        |       |
| 25Cr–7Ni–3.5Mo–W–Cb                     | ...                     |      | A995 Gr. CD3MWCuN [Note (1)] |      | ...                        |       |
| 25Cr–7Ni–3.5Mo–N–Cu–W                   | A182 Gr. F55 [Note (1)] |      | ...                          |      | A240 Gr. S32760 [Note (1)] |       |
| <b>Working Pressure by Classes, bar</b> |                         |      |                              |      |                            |       |
| Temperature, °C                         | 75                      | 150  | 300                          | 400  | 600                        | 900   |
| –29 to 38                               | 10.0                    | 20.0 | 51.7                         | 68.9 | 103.4                      | 155.1 |
| 50                                      | 9.8                     | 19.5 | 51.7                         | 68.9 | 103.4                      | 155.1 |
| 100                                     | 8.8                     | 17.7 | 50.7                         | 67.5 | 101.3                      | 152.0 |
| 150                                     | 7.9                     | 15.8 | 45.9                         | 61.2 | 91.9                       | 137.8 |
| 200                                     | 6.9                     | 13.8 | 42.7                         | 56.9 | 85.3                       | 128.0 |
| 250                                     | 6.0                     | 12.1 | 40.5                         | 53.9 | 80.9                       | 121.4 |
| 300                                     | 5.1                     | 10.2 | 38.9                         | 51.8 | 77.7                       | 116.6 |
| 325                                     | 4.6                     | 9.3  | 38.2                         | 50.9 | 76.3                       | 114.5 |
| 350                                     | 3.1                     | 8.4  | 37.6                         | 50.2 | 75.3                       | 112.9 |
| 375                                     | ...                     | 7.4  | 37.4                         | 49.8 | 74.7                       | 112.1 |
| 400                                     | ...                     | 6.5  | 36.5                         | 48.9 | 73.3                       | 109.8 |

NOTE: (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 315°C.



**Table 25 Pressure–Temperature Ratings for Group 2.9 Materials**

| Nominal Designation              | Forgings |      | Castings |      | Plates                        |       |
|----------------------------------|----------|------|----------|------|-------------------------------|-------|
|                                  |          |      |          |      |                               |       |
| 23Cr–12Ni                        | ...      |      | ...      |      | A240 Gr. 309S [Notes (1)–(3)] |       |
| 25Cr–20Ni                        | ...      |      | ...      |      | A240 Gr. 310S [Notes (1)–(3)] |       |
| Working Pressure by Classes, bar |          |      |          |      |                               |       |
| Temperature, °C                  | 75       | 150  | 300      | 400  | 600                           | 900   |
| –29 to 38                        | 9.5      | 19.0 | 49.6     | 66.2 | 99.3                          | 148.9 |
| 50                               | 9.3      | 18.5 | 48.3     | 64.4 | 96.6                          | 144.9 |
| 100                              | 8.3      | 16.5 | 43.1     | 57.5 | 86.2                          | 129.3 |
| 150                              | 7.7      | 15.3 | 40.0     | 53.3 | 80.0                          | 120.0 |
| 200                              | 6.9      | 13.8 | 37.6     | 50.1 | 75.2                          | 112.8 |
| 250                              | 6.0      | 12.1 | 35.8     | 47.7 | 71.5                          | 107.3 |
| 300                              | 5.1      | 10.2 | 34.5     | 45.9 | 68.9                          | 103.4 |
| 325                              | 4.6      | 9.3  | 33.9     | 45.2 | 67.7                          | 101.6 |
| 350                              | 3.1      | 8.4  | 33.3     | 44.4 | 66.6                          | 99.9  |
| 375                              | ...      | 7.4  | 32.9     | 43.8 | 65.7                          | 98.6  |
| 400                              | ...      | 6.5  | 32.4     | 43.2 | 64.8                          | 97.3  |
| 425                              | ...      | 5.5  | 32.1     | 42.8 | 64.2                          | 96.4  |
| 450                              | ...      | 4.6  | 31.7     | 42.2 | 63.4                          | 95.1  |
| 475                              | ...      | 3.7  | 31.2     | 41.7 | 62.5                          | 93.7  |
| 500                              | ...      | 2.8  | 28.2     | 37.6 | 56.5                          | 84.7  |
| 538                              | ...      | 1.4  | 23.4     | 31.2 | 46.8                          | 70.2  |
| 550                              | ...      | ...  | 20.5     | 27.3 | 41.0                          | 61.5  |
| 575                              | ...      | ...  | 15.1     | 20.1 | 30.2                          | 45.3  |
| 600                              | ...      | ...  | 11.0     | 14.7 | 22.1                          | 33.1  |
| 625                              | ...      | ...  | 8.1      | 10.9 | 16.3                          | 24.4  |
| 650                              | ...      | ...  | 5.8      | 7.8  | 11.6                          | 17.4  |
| 675                              | ...      | ...  | 3.7      | 4.9  | 7.4                           | 11.1  |
| 700                              | ...      | ...  | 2.2      | 2.9  | 4.3                           | 6.5   |
| 725                              | ...      | ...  | 1.4      | 1.8  | 2.7                           | 4.1   |
| 750                              | ...      | ...  | 1.0      | 1.4  | 2.1                           | 3.1   |
| 775                              | ...      | ...  | 0.8      | 1.1  | 1.6                           | 2.5   |
| 800                              | ...      | ...  | 0.6      | 0.8  | 1.2                           | 1.8   |
| 816                              | ...      | ...  | 0.5      | 0.6  | 0.9                           | 1.4   |

## NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 538°C, use only if the material is solution heat treated to the minimum temperature specified in the specification, but not lower than 1 035°C, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 565°C and above only when assurance is provided that grain size is not finer than ASTM 6.

**Table 26 Pressure–Temperature Ratings for Group 2.10 Materials**

| Nominal Designation              | Forgings |      | Castings                 |      |      | Plates |
|----------------------------------|----------|------|--------------------------|------|------|--------|
| 25Cr–12Ni                        | ...      |      | A351 Gr. CH8 [Note (1)]  |      |      | ...    |
| 25Cr–12Ni                        | ...      |      | A351 Gr. CH20 [Note (1)] |      |      | ...    |
| Working Pressure by Classes, bar |          |      |                          |      |      |        |
| Temperature, °C                  | 75       | 150  | 300                      | 400  | 600  | 900    |
| –29 to 38                        | 8.9      | 17.8 | 46.3                     | 61.8 | 92.7 | 139.0  |
| 50                               | 8.5      | 17.0 | 44.5                     | 59.3 | 89.0 | 133.4  |
| 100                              | 7.2      | 14.4 | 37.5                     | 50.0 | 75.1 | 112.6  |
| 150                              | 6.7      | 13.4 | 34.9                     | 46.5 | 69.8 | 104.7  |
| 200                              | 6.4      | 12.9 | 33.5                     | 44.7 | 67.1 | 100.6  |
| 250                              | 6.0      | 12.1 | 32.6                     | 43.5 | 65.2 | 97.8   |
| 300                              | 5.1      | 10.2 | 31.7                     | 42.3 | 63.4 | 95.2   |
| 325                              | 4.6      | 9.3  | 31.2                     | 41.6 | 62.4 | 93.6   |
| 350                              | 3.1      | 8.4  | 30.6                     | 40.8 | 61.2 | 91.7   |
| 375                              | ...      | 7.4  | 29.8                     | 39.8 | 59.7 | 89.5   |
| 400                              | ...      | 6.5  | 29.1                     | 38.8 | 58.2 | 87.3   |
| 425                              | ...      | 5.5  | 28.3                     | 37.8 | 56.7 | 85.0   |
| 450                              | ...      | 4.6  | 27.6                     | 36.8 | 55.2 | 82.8   |
| 475                              | ...      | 3.7  | 26.7                     | 35.6 | 53.5 | 80.2   |
| 500                              | ...      | 2.8  | 25.8                     | 34.5 | 51.7 | 77.5   |
| 538                              | ...      | 1.4  | 23.3                     | 31.1 | 46.6 | 70.0   |
| 550                              | ...      | ...  | 21.9                     | 29.2 | 43.8 | 65.7   |
| 575                              | ...      | ...  | 18.5                     | 24.6 | 37.0 | 55.5   |
| 600                              | ...      | ...  | 14.5                     | 19.4 | 29.0 | 43.5   |
| 625                              | ...      | ...  | 11.4                     | 15.2 | 22.8 | 34.3   |
| 650                              | ...      | ...  | 8.9                      | 11.9 | 17.8 | 26.7   |
| 675                              | ...      | ...  | 7.0                      | 9.3  | 14.0 | 20.9   |
| 700                              | ...      | ...  | 5.7                      | 7.6  | 11.3 | 17.0   |
| 725                              | ...      | ...  | 4.6                      | 6.1  | 9.1  | 13.7   |
| 750                              | ...      | ...  | 3.5                      | 4.7  | 7.0  | 10.5   |
| 775                              | ...      | ...  | 2.6                      | 3.4  | 5.1  | 7.7    |
| 800                              | ...      | ...  | 2.0                      | 2.7  | 4.0  | 6.1    |
| 816                              | ...      | ...  | 1.9                      | 2.5  | 3.8  | 5.7    |

NOTE: (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

**Table 27 Pressure–Temperature Ratings for Group 2.11 Materials**

| Nominal Designation | Forgings                         |                          | Castings |      |      | Plates |
|---------------------|----------------------------------|--------------------------|----------|------|------|--------|
|                     | Working Pressure by Classes, bar |                          |          |      |      |        |
| Temperature, °C     | 75                               | 150                      | 300      | 400  | 600  | 900    |
| 18Cr–10Ni–Cb        | ...                              | A351 Gr. CF8C [Note (1)] |          |      | ...  | ...    |
| –29 to 38           | 9.5                              | 19.0                     | 49.6     | 66.2 | 99.3 | 148.9  |
| 50                  | 9.3                              | 18.7                     | 48.8     | 65.0 | 97.5 | 146.3  |
| 100                 | 8.7                              | 17.4                     | 45.3     | 60.4 | 90.6 | 135.9  |
| 150                 | 7.9                              | 15.8                     | 42.5     | 56.6 | 84.9 | 127.4  |
| 200                 | 6.9                              | 13.8                     | 39.9     | 53.3 | 79.9 | 119.8  |
| 250                 | 6.0                              | 12.1                     | 37.8     | 50.4 | 75.6 | 113.4  |
| 300                 | 5.1                              | 10.2                     | 36.1     | 48.1 | 72.2 | 108.3  |
| 325                 | 4.6                              | 9.3                      | 35.4     | 47.1 | 70.7 | 106.1  |
| 350                 | 3.1                              | 8.4                      | 34.8     | 46.3 | 69.5 | 104.3  |
| 375                 | ...                              | 7.4                      | 34.2     | 45.6 | 68.4 | 102.6  |
| 400                 | ...                              | 6.5                      | 33.9     | 45.2 | 67.8 | 101.7  |
| 425                 | ...                              | 5.5                      | 33.6     | 44.8 | 67.2 | 100.8  |
| 450                 | ...                              | 4.6                      | 33.5     | 44.6 | 66.9 | 100.4  |
| 475                 | ...                              | 3.7                      | 31.7     | 42.3 | 63.4 | 95.1   |
| 500                 | ...                              | 2.8                      | 28.2     | 37.6 | 56.5 | 84.7   |
| 538                 | ...                              | 1.4                      | 25.2     | 33.4 | 50.0 | 75.2   |
| 550                 | ...                              | ...                      | 25.0     | 33.3 | 49.8 | 74.8   |
| 575                 | ...                              | ...                      | 24.0     | 31.9 | 47.9 | 71.8   |
| 600                 | ...                              | ...                      | 19.8     | 26.4 | 39.6 | 59.4   |
| 625                 | ...                              | ...                      | 13.9     | 18.5 | 27.7 | 41.6   |
| 650                 | ...                              | ...                      | 10.3     | 13.7 | 20.6 | 30.9   |
| 675                 | ...                              | ...                      | 8.0      | 10.6 | 15.9 | 23.9   |
| 700                 | ...                              | ...                      | 5.6      | 7.5  | 11.2 | 16.8   |
| 725                 | ...                              | ...                      | 4.0      | 5.3  | 8.0  | 11.9   |
| 750                 | ...                              | ...                      | 3.1      | 4.1  | 6.2  | 9.3    |
| 775                 | ...                              | ...                      | 2.5      | 3.3  | 4.9  | 7.4    |
| 800                 | ...                              | ...                      | 2.0      | 2.7  | 4.0  | 6.1    |
| 816                 | ...                              | ...                      | 1.9      | 2.5  | 3.8  | 5.7    |

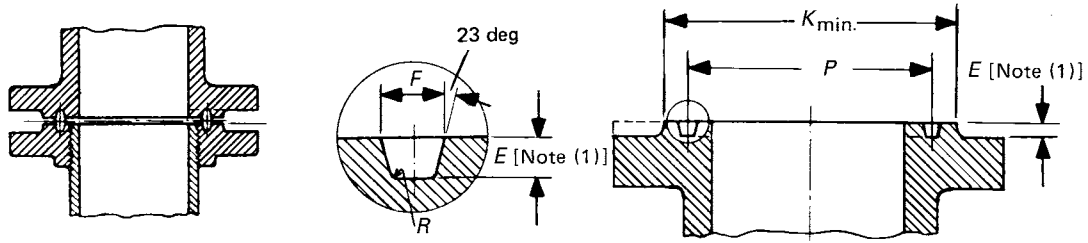
NOTE: (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

**Table 28 Pressure–Temperature Ratings for Group 2.12 Materials**

| Nominal Designation | Forgings                         |                          | Castings |      |      | Plates |
|---------------------|----------------------------------|--------------------------|----------|------|------|--------|
|                     | Working Pressure by Classes, bar |                          |          |      |      |        |
| Temperature, °C     | 75                               | 150                      | 300      | 400  | 600  | 900    |
| 25Cr–20Ni           | ...                              | A351 Gr. CK20 [Note (1)] |          |      | ...  | ...    |
| –29 to 38           | 8.9                              | 17.8                     | 46.3     | 61.8 | 92.7 | 139.0  |
| 50                  | 8.5                              | 17.0                     | 44.5     | 59.3 | 89.0 | 133.4  |
| 100                 | 7.2                              | 14.4                     | 37.5     | 50.0 | 75.1 | 112.6  |
| 150                 | 6.7                              | 13.4                     | 34.9     | 46.5 | 69.8 | 104.7  |
| 200                 | 6.4                              | 12.9                     | 33.5     | 44.7 | 67.1 | 100.6  |
| 250                 | 6.0                              | 12.1                     | 32.6     | 43.5 | 65.2 | 97.8   |
| 300                 | 5.1                              | 10.2                     | 31.7     | 42.3 | 63.4 | 95.2   |
| 325                 | 4.6                              | 9.3                      | 31.2     | 41.6 | 62.4 | 93.6   |
| 350                 | 3.1                              | 8.4                      | 30.6     | 40.8 | 61.2 | 91.7   |
| 375                 | ...                              | 7.4                      | 29.8     | 39.8 | 59.7 | 89.5   |
| 400                 | ...                              | 6.5                      | 29.1     | 38.8 | 58.2 | 87.3   |
| 425                 | ...                              | 5.5                      | 28.3     | 37.8 | 56.7 | 85.0   |
| 450                 | ...                              | 4.6                      | 27.6     | 36.8 | 55.2 | 82.8   |
| 475                 | ...                              | 3.7                      | 26.7     | 35.6 | 53.5 | 80.2   |
| 500                 | ...                              | 2.8                      | 25.8     | 34.5 | 51.7 | 77.5   |
| 538                 | ...                              | 1.4                      | 23.3     | 31.1 | 46.6 | 70.0   |
| 550                 | ...                              | ...                      | 22.9     | 30.6 | 45.9 | 68.8   |
| 575                 | ...                              | ...                      | 21.7     | 28.9 | 43.3 | 65.0   |
| 600                 | ...                              | ...                      | 19.4     | 25.9 | 38.8 | 58.2   |
| 625                 | ...                              | ...                      | 16.8     | 22.4 | 33.7 | 50.5   |
| 650                 | ...                              | ...                      | 14.1     | 18.8 | 28.1 | 42.2   |
| 675                 | ...                              | ...                      | 11.5     | 15.4 | 23.0 | 34.6   |
| 700                 | ...                              | ...                      | 8.8      | 11.7 | 17.5 | 26.3   |
| 725                 | ...                              | ...                      | 6.3      | 8.5  | 12.7 | 19.0   |
| 750                 | ...                              | ...                      | 4.5      | 6.0  | 8.9  | 13.4   |
| 775                 | ...                              | ...                      | 3.1      | 4.2  | 6.3  | 9.4    |
| 800                 | ...                              | ...                      | 2.3      | 3.1  | 4.6  | 6.9    |
| 816                 | ...                              | ...                      | 1.9      | 2.5  | 3.8  | 5.7    |

NOTE: (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

**Table 29 Dimensions of Ring-Joint Facings**



| Nominal Pipe Size for Class |     |     |     | Groove Number | Groove Dimensions        |                 |                 | Diameter of Raised Portion, <i>K</i> |                            |
|-----------------------------|-----|-----|-----|---------------|--------------------------|-----------------|-----------------|--------------------------------------|----------------------------|
| 300                         | 400 | 600 | 900 |               | Pitch Diameter, <i>P</i> | Depth, <i>E</i> | Width, <i>F</i> |                                      | Radius at Bottom, <i>R</i> |
| 26                          | 26  | 26  | ... | R93           | 749.30                   | 12.70           | 19.84           | 1.5                                  | 810                        |
| 28                          | 28  | 28  | ... | R94           | 800.10                   | 12.70           | 19.84           | 1.5                                  | 861                        |
| 30                          | 30  | 30  | ... | R95           | 857.25                   | 12.70           | 19.84           | 1.5                                  | 917                        |
| 32                          | 32  | 32  | ... | R96           | 914.40                   | 14.27           | 23.01           | 1.5                                  | 984                        |
| 34                          | 34  | 34  | ... | R97           | 965.20                   | 14.27           | 23.01           | 1.5                                  | 1 035                      |
| 36                          | 36  | 36  | ... | R98           | 1 022.35                 | 14.27           | 23.01           | 1.5                                  | 1 092                      |
| ...                         | ... | ... | 26  | R100          | 749.30                   | 17.48           | 30.18           | 2.3                                  | 832                        |
| ...                         | ... | ... | 28  | R101          | 800.10                   | 17.48           | 33.32           | 2.3                                  | 889                        |
| ...                         | ... | ... | 30  | R102          | 857.25                   | 17.48           | 33.32           | 2.3                                  | 946                        |
| ...                         | ... | ... | 32  | R103          | 914.40                   | 17.48           | 33.32           | 2.3                                  | 1 003                      |
| ...                         | ... | ... | 34  | R104          | 965.20                   | 20.62           | 36.53           | 2.3                                  | 1 067                      |
| ...                         | ... | ... | 36  | R105          | 1 022.35                 | 20.62           | 36.53           | 2.3                                  | 1 124                      |

**Tolerances**

|                             |   |
|-----------------------------|---|
| <i>E</i> (depth)            | +0.4, -0.0                                    |
| <i>F</i> (width)            | ±0.2  |
| <i>P</i> (pitch diameter)   | ±0.13   |
| <i>R</i> (radius at bottom) | +0.8, -0.0 for $R \leq 2$<br>±0.8 for $R > 2$ |
| 23 deg angle                | ±½ deg  |

**GENERAL NOTES:**

- (a) Dimensions are in millimeters.
- (b) Ring-joint gaskets are not contemplated for NPS 38 and larger flanges.
- (c) For facing requirements for flanges, see para. 6.1.
- (d) See para. 4.2 for marking requirements.

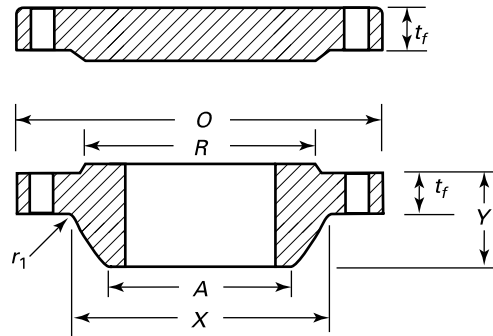
NOTE: (1) Height of raised portion is equal to the depth of groove dimension *E*, but is not subjected to the tolerances for *E*. Full face contour may be used.

**Table 30 Permissible Imperfections in Flange Facing Finish**

| Nominal Pipe Size | Maximum Radial Projection of Imperfections That Are No Deeper Than Bottom of Serration, mm | Maximum Depth and Radial Projection of Imperfections That Are Deeper Than Bottom of Serration, mm |
|-------------------|--|---|
| 26-36             | 12.5   | 6.0   |
| 38-48             | 14.0   | 7.0   |
| 50-60             | 16.0   | 8.0   |

GENERAL NOTE: See para. 6.1.5.

**Table 31 Dimensions of Class 150 Series A Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               | Diam. of Bolt, in. |
| 26                | 870                 | 66.7  | 66.7  | 119                     | 676                          | 660.4                         | 749                    | 806.4                | 24                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 10                 |
| 28                | 925                 | 69.9  | 69.9  | 124                     | 727                          | 711.2                         | 800                    | 863.6                | 28                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 11                 |
| 30                | 985                 | 73.1  | 73.1  | 135                     | 781                          | 762.0                         | 857                    | 914.4                | 28                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 11                 |
| 32                | 1 060               | 79.4  | 79.4  | 143                     | 832                          | 812.8                         | 914                    | 977.9                | 28                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 11                 |
| 34                | 1 110               | 81.0  | 81.0  | 148                     | 883                          | 863.6                         | 965                    | 1 028.7              | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 36                | 1 170               | 88.9  | 88.9  | 156                     | 933                          | 914.4                         | 1 022                  | 1 085.8              | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 38                | 1 240               | 85.8  | 85.8  | 156                     | 991                          | 965.2                         | 1 073                  | 1 149.4              | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 40                | 1 290               | 88.9  | 88.9  | 162                     | 1 041                        | 1 016.0                       | 1 124                  | 1 200.2              | 36                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 42                | 1 345               | 95.3  | 95.3  | 170                     | 1 092                        | 1 066.8                       | 1 194                  | 1 257.3              | 36                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 44                | 1 405               | 100.1   | 100.1 | 176                     | 1 143                        | 1 117.6                       | 1 245                  | 1 314.4              | 40                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 46                | 1 455               | 101.6   | 101.6 | 184                     | 1 197                        | 1 168.4                       | 1 295                  | 1 365.2              | 40                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 48                | 1 510               | 106.4   | 106.4 | 191                     | 1 248                        | 1 219.2                       | 1 359                  | 1 422.4              | 44                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 13                 |
| 50                | 1 570               | 109.6   | 109.6 | 202                     | 1 302                        | 1 270.0                       | 1 410                  | 1 479.6              | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |
| 52                | 1 625               | 114.3   | 114.3 | 208                     | 1 353                        | 1 320.8                       | 1 461                  | 1 536.7              | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |
| 54                | 1 685               | 119.1   | 119.1 | 214                     | 1 403                        | 1 371.6                       | 1 511                  | 1 593.8              | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |
| 56                | 1 745               | 122.3   | 122.3 | 227                     | 1 457                        | 1 422.4                       | 1 575                  | 1 651.0              | 48                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |
| 58                | 1 805               | 127.0   | 127.0 | 233                     | 1 508                        | 1 473.2                       | 1 626                  | 1 708.2              | 48                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |
| 60                | 1 855               | 130.2   | 130.2 | 238                     | 1 559                        | 1 524.0                       | 1 676                  | 1 759.0              | 52                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                 |

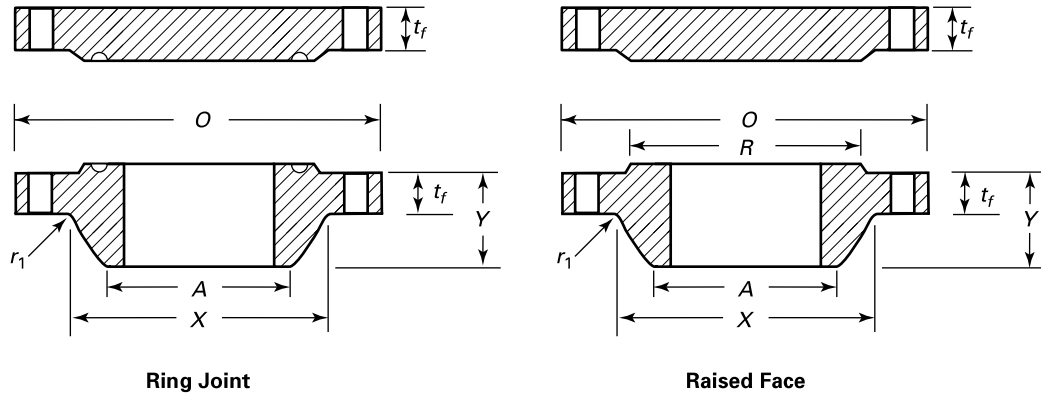
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table 32 Dimensions of Class 300 Series A Flanges**



| Nominal Pipe Size | O.D. of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> [Note (1)] |       | Length Through Hub, <i>Y</i> | Diam. of Hub, <i>X</i> [Note (2)] | Hub Diam. Top, <i>A</i> [Note (3)] | Raised Face Diam., <i>R</i> | Drilling             |                   |                               | Minimum Fillet Radius, <i>r<sub>1</sub></i> |    |
|-------------------|--------------------------|--|-------|------------------------------|-----------------------------------|------------------------------------|-----------------------------|----------------------|-------------------|-------------------------------|---|----|
|                   |                          | WNF  | Blind |                              |                                   |                                    |                             | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |   |    |
| 26                | 970                      | 77.8   | 82.6  | 183                          | 721                               | 660.4                              | 749                         | 876.3                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 10 |
| 28                | 1 035                    | 84.2   | 88.9  | 195                          | 775                               | 711.2                              | 800                         | 939.8                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 11 |
| 30                | 1 090                    | 90.5   | 93.7  | 208                          | 827                               | 762.0                              | 857                         | 997.0                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 11 |
| 32                | 1 150                    | 96.9   | 98.5  | 221                          | 881                               | 812.8                              | 914                         | 1 054.1              | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 11 |
| 34                | 1 205                    | 100.1  | 103.2 | 230                          | 937                               | 863.6                              | 965                         | 1 104.9              | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 13 |
| 36                | 1 270                    | 103.2  | 109.6 | 240                          | 991                               | 914.4                              | 1 022                       | 1 168.4              | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 13 |
| 38                | 1 170                    | 106.4  | 106.4 | 179                          | 994                               | 965.2                              | 1 029                       | 1 092.2              | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub>               | 13 |
| 40                | 1 240                    | 112.8  | 112.8 | 192                          | 1 048                             | 1 016.0                            | 1 086                       | 1 155.7              | 32                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 13 |
| 42                | 1 290                    | 117.5  | 117.5 | 198                          | 1 099                             | 1 066.8                            | 1 137                       | 1 206.5              | 32                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 13 |
| 44                | 1 355                    | 122.3  | 122.3 | 205                          | 1 149                             | 1 117.6                            | 1 194                       | 1 263.6              | 32                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 13 |
| 46                | 1 415                    | 127.0  | 127.0 | 214                          | 1 203                             | 1 168.4                            | 1 245                       | 1 320.8              | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 13 |
| 48                | 1 465                    | 131.8  | 131.8 | 222                          | 1 254                             | 1 219.2                            | 1 302                       | 1 371.6              | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 13 |
| 50                | 1 530                    | 138.2  | 138.2 | 230                          | 1 305                             | 1 270.0                            | 1 359                       | 1 428.8              | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 13 |
| 52                | 1 580                    | 142.9  | 142.9 | 237                          | 1 356                             | 1 320.8                            | 1 410                       | 1 479.6              | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 13 |
| 54                | 1 660                    | 150.9  | 150.9 | 251                          | 1 410                             | 1 371.6                            | 1 467                       | 1 549.4              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 13 |
| 56                | 1 710                    | 152.4  | 152.4 | 259                          | 1 464                             | 1 422.4                            | 1 518                       | 1 600.2              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 13 |
| 58                | 1 760                    | 157.2  | 157.2 | 265                          | 1 514                             | 1 473.2                            | 1 575                       | 1 651.0              | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 13 |
| 60                | 1 810                    | 162.0  | 162.0 | 271                          | 1 565                             | 1 524.0                            | 1 626                       | 1 701.8              | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 13 |

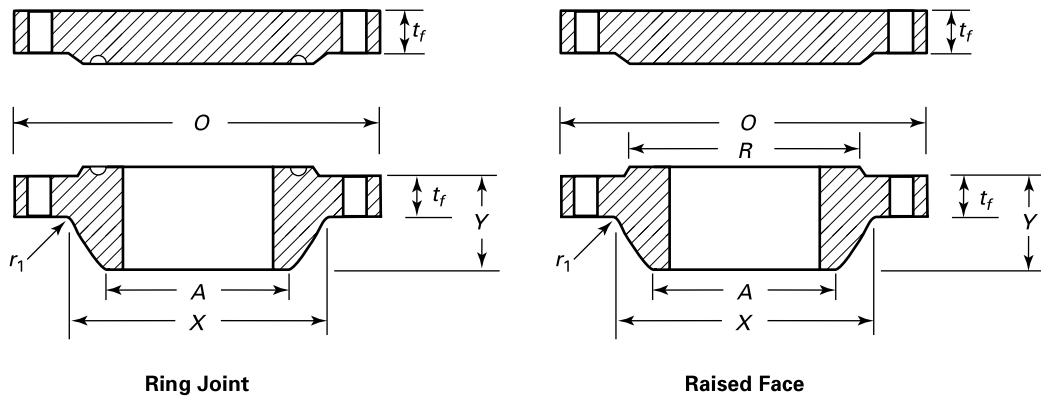
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table 33 Dimensions of Class 400 Series A Flanges**



| Nominal Pipe Size | O.D. of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> [Note (1)] |       | Length Through Hub, <i>Y</i> | Diam. of Hub, <i>X</i> [Note (2)] | Hub Diam. Top, <i>A</i> [Note (3)] | Raised Face Diam., <i>R</i> | Drilling             |                   |                               | Minimum Fillet Radius, <i>r<sub>1</sub></i> |                    |
|-------------------|--------------------------|--|-------|------------------------------|-----------------------------------|------------------------------------|-----------------------------|----------------------|-------------------|-------------------------------|---|--------------------|
|                   |                          | WNF  | Blind |                              |                                   |                                    |                             | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |   | Diam. of Bolt, in. |
| 26                | 970                      | 88.9   | 98.5  | 194                          | 727                               | 660.4                              | 749                         | 876.3                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 11                 |
| 28                | 1 035                    | 95.3   | 104.8 | 206                          | 783                               | 711.2                              | 800                         | 939.8                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 13                 |
| 30                | 1 090                    | 101.6  | 111.2 | 219                          | 837                               | 762.0                              | 857                         | 997.0                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 13                 |
| 32                | 1 150                    | 108.0  | 115.9 | 232                          | 889                               | 812.8                              | 914                         | 1 054.1              | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 13                 |
| 34                | 1 205                    | 111.2  | 122.3 | 241                          | 945                               | 863.6                              | 965                         | 1 104.9              | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 14                 |
| 36                | 1 270                    | 114.3  | 128.6 | 251                          | 1 000                             | 914.4                              | 1 022                       | 1 168.4              | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 14                 |
| 38                | 1 205                    | 123.9  | 123.9 | 206                          | 1 003                             | 965.2                              | 1 035                       | 1 117.6              | 32                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 14                 |
| 40                | 1 270                    | 130.2  | 130.2 | 216                          | 1 054                             | 1 016.0                            | 1 092                       | 1 174.8              | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 14                 |
| 42                | 1 320                    | 133.4  | 133.4 | 224                          | 1 108                             | 1 066.8                            | 1 143                       | 1 225.6              | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 14                 |
| 44                | 1 385                    | 139.7  | 139.7 | 233                          | 1 159                             | 1 117.6                            | 1 200                       | 1 282.7              | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 14                 |
| 46                | 1 440                    | 146.1  | 146.1 | 244                          | 1 213                             | 1 168.4                            | 1 257                       | 1 339.8              | 36                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 14                 |
| 48                | 1 510                    | 152.4  | 152.4 | 257                          | 1 267                             | 1 219.2                            | 1 308                       | 1 403.4              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 14                 |
| 50                | 1 570                    | 157.2  | 158.8 | 268                          | 1 321                             | 1 270.0                            | 1 362                       | 1 460.5              | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 14                 |
| 52                | 1 620                    | 162.0  | 163.6 | 276                          | 1 372                             | 1 320.8                            | 1 413                       | 1 511.3              | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 14                 |
| 54                | 1 700                    | 169.9  | 171.5 | 289                          | 1 426                             | 1 371.6                            | 1 470                       | 1 581.2              | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 14                 |
| 56                | 1 755                    | 174.7  | 176.3 | 298                          | 1 480                             | 1 422.4                            | 1 527                       | 1 632.0              | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 14                 |
| 58                | 1 805                    | 177.8  | 181.0 | 306                          | 1 530                             | 1 473.2                            | 1 578                       | 1 682.8              | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 14                 |
| 60                | 1 885                    | 185.8  | 189.0 | 319                          | 1 584                             | 1 524.0                            | 1 635                       | 1 752.6              | 32                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub>               | 14                 |

GENERAL NOTES:

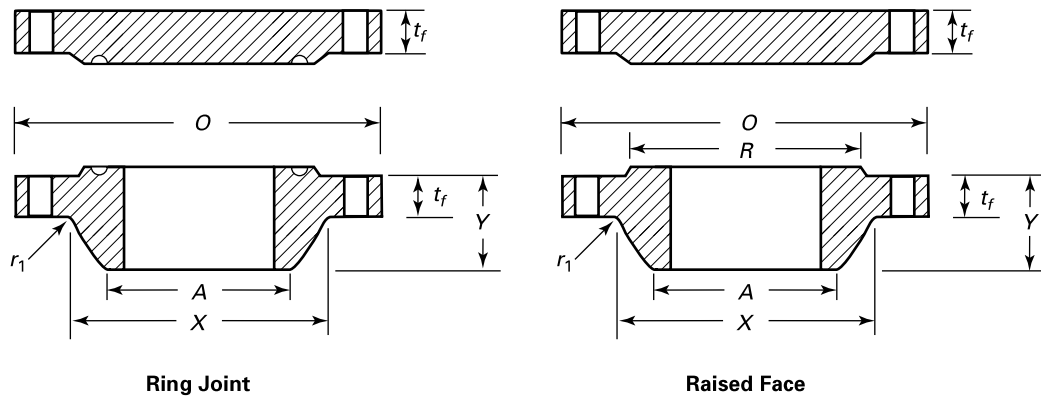
- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.



Table 34 Dimensions of Class 600 Series A Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               | Diam. of Bolt, in. |
| 26                | 1 015               | 108.0   | 125.5 | 222                     | 748                          | 660.4                         | 749                    | 914.4                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 13                 |
| 28                | 1 075               | 111.2   | 131.8 | 235                     | 803                          | 711.2                         | 800                    | 965.2                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 13                 |
| 30                | 1 130               | 114.3   | 139.7 | 248                     | 862                          | 762.0                         | 857                    | 1 022.4              | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 13                 |
| 32                | 1 195               | 117.5   | 147.7 | 260                     | 918                          | 812.8                         | 914                    | 1 079.5              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 13                 |
| 34                | 1 245               | 120.7   | 154.0 | 270                     | 973                          | 863.6                         | 965                    | 1 130.3              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 14                 |
| 36                | 1 315               | 123.9   | 162.0 | 283                     | 1 032                        | 914.4                         | 1 022                  | 1 193.8              | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 14                 |
| 38                | 1 270               | 152.4   | 155.0 | 254                     | 1 022                        | 965.2                         | 1 054                  | 1 162.0              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 14                 |
| 40                | 1 320               | 158.8   | 162.0 | 264                     | 1 073                        | 1 016.0                       | 1 111                  | 1 212.8              | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 14                 |
| 42                | 1 405               | 168.3   | 171.5 | 279                     | 1 127                        | 1 066.8                       | 1 168                  | 1 282.7              | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 14                 |
| 44                | 1 455               | 173.1   | 177.8 | 289                     | 1 181                        | 1 117.6                       | 1 226                  | 1 333.5              | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 14                 |
| 46                | 1 510               | 179.4   | 185.8 | 300                     | 1 235                        | 1 168.4                       | 1 276                  | 1 390.6              | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 14                 |
| 48                | 1 595               | 189.0   | 195.3 | 316                     | 1 289                        | 1 219.2                       | 1 334                  | 1 460.5              | 32                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub> | 14                 |
| 50                | 1 670               | 196.9   | 203.2 | 329                     | 1 343                        | 1 270.0                       | 1 384                  | 1 524.0              | 28                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 14                 |
| 52                | 1 720               | 203.2   | 209.6 | 337                     | 1 394                        | 1 320.8                       | 1 435                  | 1 574.8              | 32                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 14                 |
| 54                | 1 780               | 209.6   | 217.5 | 349                     | 1 448                        | 1 371.6                       | 1 492                  | 1 632.0              | 32                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 14                 |
| 56                | 1 855               | 217.5   | 225.5 | 362                     | 1 502                        | 1 422.4                       | 1 543                  | 1 695.4              | 32                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 16                 |
| 58                | 1 905               | 222.3   | 231.8 | 370                     | 1 553                        | 1 473.2                       | 1 600                  | 1 746.2              | 32                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 16                 |
| 60                | 1 995               | 233.4   | 242.9 | 389                     | 1 610                        | 1 524.0                       | 1 657                  | 1 822.4              | 28                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 17                 |

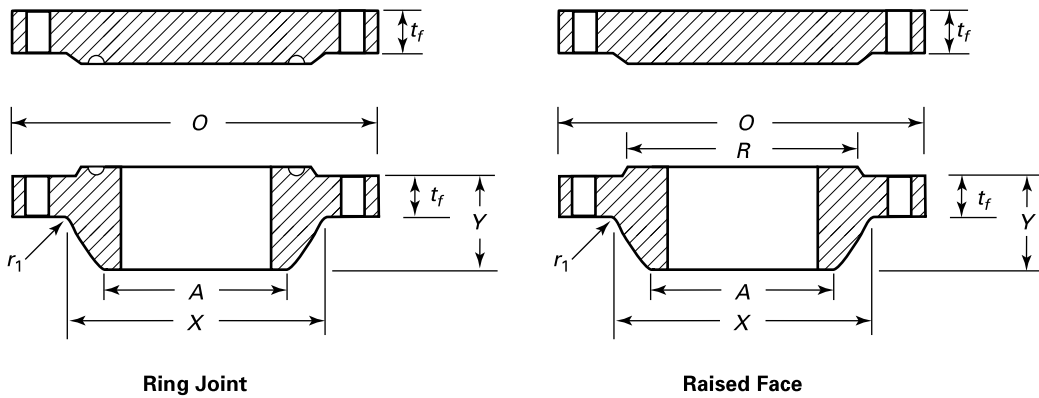
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table 35 Dimensions of Class 900 Series A Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               | Diam. of Bolt, in. |
| 26                | 1 085               | 139.7   | 160.4 | 286                     | 775                          | 660.4                         | 749                    | 952.5                | 20                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub> | 11                 |
| 28                | 1 170               | 142.9   | 171.5 | 298                     | 832                          | 711.2                         | 800                    | 1 022.4              | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 13                 |
| 30                | 1 230               | 149.3   | 182.6 | 311                     | 889                          | 762.0                         | 857                    | 1 085.8              | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 13                 |
| 32                | 1 315               | 158.8   | 193.7 | 330                     | 946                          | 812.8                         | 914                    | 1 155.7              | 20                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 13                 |
| 34                | 1 395               | 165.1   | 204.8 | 349                     | 1 006                        | 863.6                         | 965                    | 1 225.6              | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 14                 |
| 36                | 1 460               | 171.5   | 214.4 | 362                     | 1 064                        | 914.4                         | 1 022                  | 1 289.0              | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 14                 |
| 38                | 1 460               | 190.5   | 215.9 | 352                     | 1 073                        | 965.2                         | 1 099                  | 1 289.0              | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 19                 |
| 40                | 1 510               | 196.9   | 223.9 | 364                     | 1 127                        | 1 016.0                       | 1 162                  | 1 339.8              | 24                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 21                 |
| 42                | 1 560               | 206.4   | 231.8 | 371                     | 1 176                        | 1 066.8                       | 1 213                  | 1 390.6              | 24                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 21                 |
| 44                | 1 650               | 214.4   | 242.9 | 391                     | 1 235                        | 1 117.6                       | 1 270                  | 1 463.7              | 24                | 3 <sup>7</sup> / <sub>8</sub> | 3 <sup>3</sup> / <sub>4</sub> | 22                 |
| 46                | 1 735               | 225.5   | 255.6 | 411                     | 1 292                        | 1 168.4                       | 1 334                  | 1 536.7              | 24                | 4 <sup>1</sup> / <sub>8</sub> | 4                             | 22                 |
| 48                | 1 785               | 233.4   | 263.6 | 419                     | 1 343                        | 1 219.2                       | 1 384                  | 1 587.5              | 24                | 4 <sup>1</sup> / <sub>8</sub> | 4                             | 24                 |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |

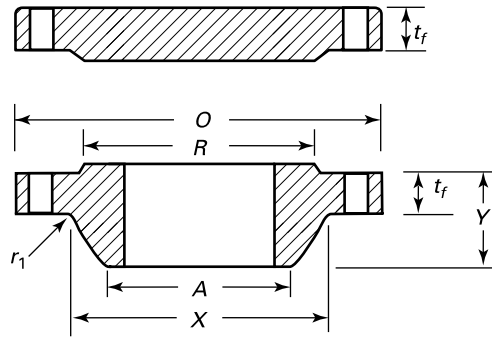
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table 36 Dimensions of Class 75 Series B Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                         | Minimum Fillet Radius, $r_1$ |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------|------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in. |                              | Diam. of Bolt, in. |
| 26                | 760                 | 31.9  | 31.9  | 57                      | 676                          | 661.9                         | 705                    | 723.9                | 36                | $\frac{3}{4}$           | $\frac{5}{8}$                | 8                  |
| 28                | 815                 | 31.9  | 31.9  | 60                      | 727                          | 712.7                         | 756                    | 774.7                | 40                | $\frac{3}{4}$           | $\frac{5}{8}$                | 8                  |
| 30                | 865                 | 31.9  | 31.9  | 64                      | 778                          | 763.5                         | 806                    | 825.5                | 44                | $\frac{3}{4}$           | $\frac{5}{8}$                | 8                  |
| 32                | 915                 | 33.5  | 35.0  | 68                      | 829                          | 814.3                         | 857                    | 876.3                | 48                | $\frac{3}{4}$           | $\frac{5}{8}$                | 8                  |
| 34                | 965                 | 33.5  | 36.6  | 72                      | 879                          | 865.1                         | 908                    | 927.1                | 52                | $\frac{3}{4}$           | $\frac{5}{8}$                | 8                  |
| 36                | 1 035               | 35.0  | 40.9  | 84                      | 935                          | 915.9                         | 965                    | 992.2                | 40                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 38                | 1 085               | 36.6  | 43.0  | 87                      | 986                          | 966.7                         | 1 016                  | 1 043.0              | 40                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 40                | 1 135               | 36.6  | 43.0  | 91                      | 1 037                        | 1 017.5                       | 1 067                  | 1 093.8              | 44                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 42                | 1 185               | 38.2  | 46.3  | 94                      | 1 087                        | 1 068.3                       | 1 118                  | 1 144.6              | 48                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 44                | 1 250               | 41.4  | 47.7  | 103                     | 1 140                        | 1 119.1                       | 1 175                  | 1 203.3              | 36                | 1                       | $\frac{7}{8}$                | 10                 |
| 46                | 1 300               | 43.0  | 49.3  | 106                     | 1 191                        | 1 169.9                       | 1 226                  | 1 254.1              | 40                | 1                       | $\frac{7}{8}$                | 10                 |
| 48                | 1 355               | 44.6  | 52.5  | 110                     | 1 241                        | 1 220.7                       | 1 276                  | 1 304.9              | 44                | 1                       | $\frac{7}{8}$                | 10                 |
| 50                | 1 405               | 46.2  | 54.1  | 114                     | 1 294                        | 1 271.5                       | 1 327                  | 1 355.7              | 44                | 1                       | $\frac{7}{8}$                | 10                 |
| 52                | 1 455               | 46.2  | 55.7  | 119                     | 1 345                        | 1 322.3                       | 1 378                  | 1 409.7              | 48                | 1                       | $\frac{7}{8}$                | 10                 |
| 54                | 1 510               | 47.8  | 58.9  | 124                     | 1 397                        | 1 373.1                       | 1 429                  | 1 460.5              | 48                | 1                       | $\frac{7}{8}$                | 10                 |
| 56                | 1 575               | 49.3  | 60.4  | 133                     | 1 451                        | 1 423.9                       | 1 486                  | 1 520.8              | 40                | $1\frac{1}{8}$          | 1                            | 11                 |
| 58                | 1 625               | 50.9  | 62.0  | 137                     | 1 502                        | 1 474.7                       | 1 537                  | 1 571.6              | 44                | $1\frac{1}{8}$          | 1                            | 11                 |
| 60                | 1 675               | 54.1  | 65.2  | 143                     | 1 553                        | 1 525.5                       | 1 588                  | 1 622.4              | 44                | $1\frac{1}{8}$          | 1                            | 11                 |

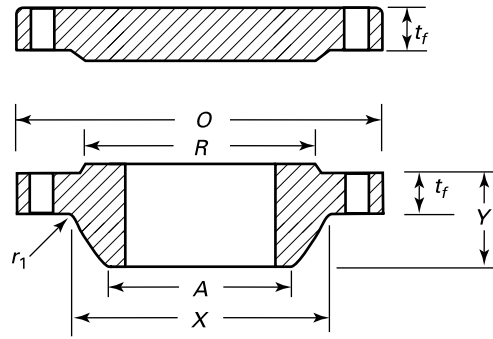
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table 37 Dimensions of Class 150 Series B Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                         | Minimum Fillet Radius, $r_1$ |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------|------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in. |                              | Diam. of Bolt, in. |
| 26                | 785                 | 39.8  | 43.0  | 87                      | 684                          | 661.9                         | 711                    | 744.5                | 36                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 28                | 835                 | 43.0  | 46.2  | 94                      | 735                          | 712.7                         | 762                    | 795.3                | 40                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 30                | 885                 | 43.0  | 49.3  | 98                      | 787                          | 763.5                         | 813                    | 846.1                | 44                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 32                | 940                 | 44.6  | 52.5  | 106                     | 840                          | 814.3                         | 864                    | 900.1                | 48                | $\frac{7}{8}$           | $\frac{3}{4}$                | 10                 |
| 34                | 1 005               | 47.7  | 55.7  | 109                     | 892                          | 865.1                         | 921                    | 957.3                | 40                | 1                       | $\frac{7}{8}$                | 10                 |
| 36                | 1 055               | 50.9  | 57.3  | 116                     | 945                          | 915.9                         | 972                    | 1 009.6              | 44                | 1                       | $\frac{7}{8}$                | 10                 |
| 38                | 1 125               | 52.5  | 62.0  | 122                     | 997                          | 968.2                         | 1 022                  | 1 070.0              | 40                | $1\frac{1}{8}$          | 1                            | 10                 |
| 40                | 1 175               | 54.1  | 65.2  | 127                     | 1 049                        | 1 019.0                       | 1 080                  | 1 120.8              | 44                | $1\frac{1}{8}$          | 1                            | 10                 |
| 42                | 1 225               | 57.3  | 66.8  | 132                     | 1 102                        | 1 069.8                       | 1 130                  | 1 171.6              | 48                | $1\frac{1}{8}$          | 1                            | 11                 |
| 44                | 1 275               | 58.9  | 70.0  | 135                     | 1 153                        | 1 120.6                       | 1 181                  | 1 222.4              | 52                | $1\frac{1}{8}$          | 1                            | 11                 |
| 46                | 1 340               | 60.4  | 73.1  | 143                     | 1 205                        | 1 171.4                       | 1 235                  | 1 284.3              | 40                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 11                 |
| 48                | 1 390               | 63.6  | 76.3  | 148                     | 1 257                        | 1 222.2                       | 1 289                  | 1 335.1              | 44                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 11                 |
| 50                | 1 445               | 66.8  | 79.5  | 152                     | 1 308                        | 1 273.0                       | 1 340                  | 1 385.9              | 48                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 11                 |
| 52                | 1 495               | 68.4  | 82.7  | 156                     | 1 360                        | 1 323.8                       | 1 391                  | 1 436.7              | 52                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 11                 |
| 54                | 1 550               | 70.0  | 85.8  | 160                     | 1 413                        | 1 374.6                       | 1 441                  | 1 492.2              | 56                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 11                 |
| 56                | 1 600               | 71.6  | 89.0  | 165                     | 1 465                        | 1 425.4                       | 1 492                  | 1 543.0              | 60                | $1\frac{1}{4}$          | $1\frac{1}{8}$               | 14                 |
| 58                | 1 675               | 73.1  | 91.9  | 173                     | 1 516                        | 1 476.2                       | 1 543                  | 1 611.3              | 48                | $1\frac{3}{8}$          | $1\frac{1}{4}$               | 14                 |
| 60                | 1 725               | 74.7  | 95.4  | 178                     | 1 570                        | 1 527.0                       | 1 600                  | 1 662.1              | 52                | $1\frac{3}{8}$          | $1\frac{1}{4}$               | 14                 |

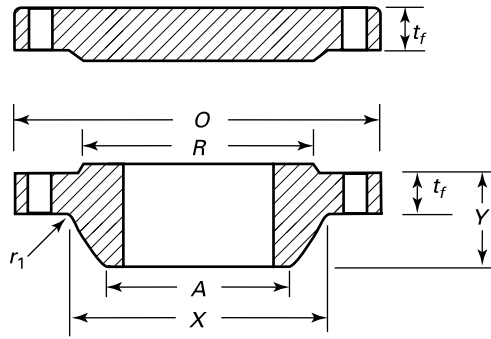
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table 38 Dimensions of Class 300 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, O | Minimum Thickness of Flange, t <sub>f</sub> [Note (1)] |       | Length Through Hub, Y | Diam. of Hub, X [Note (2)] | Hub Diam. Top, A [Note (3)] | Raised Face Diam., R | Drilling             |                   |                               | Diam. of Bolt, in.            | Minimum Fillet Radius, r <sub>1</sub> |
|-------------------|-------------------|--|-------|-----------------------|----------------------------|-----------------------------|----------------------|----------------------|-------------------|-------------------------------|-------------------------------|---------------------------------------|
|                   |                   | WNF  | Blind |                       |                            |                             |                      | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               |                                       |
| 26                | 865               | 87.4   | 87.4  | 143                   | 702                        | 665.2                       | 737                  | 803.3                | 32                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 14                                    |
| 28                | 920               | 87.4   | 87.4  | 148                   | 756                        | 716.0                       | 787                  | 857.2                | 36                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 14                                    |
| 30                | 990               | 92.1   | 92.1  | 156                   | 813                        | 768.4                       | 845                  | 920.8                | 36                | 1 <sup>1</sup> / <sub>2</sub> | 1 <sup>3</sup> / <sub>8</sub> | 14                                    |
| 32                | 1 055             | 101.6  | 101.6 | 167                   | 864                        | 819.2                       | 902                  | 977.9                | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 16                                    |
| 34                | 1 110             | 101.6  | 101.6 | 171                   | 918                        | 870.0                       | 953                  | 1 031.9              | 36                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 16                                    |
| 36                | 1 170             | 101.6  | 101.6 | 179                   | 965                        | 920.8                       | 1 010                | 1 089.0              | 32                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub> | 16                                    |
| 38                | 1 220             | 109.6  | 109.6 | 191                   | 1 016                      | 971.6                       | 1 060                | 1 139.8              | 36                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub> | 16                                    |
| 40                | 1 275             | 114.3  | 114.3 | 197                   | 1 067                      | 1 022.4                     | 1 114                | 1 190.6              | 40                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub> | 16                                    |
| 42                | 1 335             | 117.5  | 117.5 | 203                   | 1 118                      | 1 074.7                     | 1 168                | 1 244.6              | 36                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 16                                    |
| 44                | 1 385             | 125.5  | 125.5 | 213                   | 1 173                      | 1 125.5                     | 1 219                | 1 295.4              | 40                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 16                                    |
| 46                | 1 460             | 127.0  | 128.6 | 221                   | 1 229                      | 1 176.3                     | 1 270                | 1 365.2              | 36                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 16                                    |
| 48                | 1 510             | 127.0  | 133.4 | 222                   | 1 278                      | 1 227.1                     | 1 327                | 1 416.0              | 40                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 16                                    |
| 50                | 1 560             | 136.6  | 138.2 | 233                   | 1 330                      | 1 277.9                     | 1 378                | 1 466.8              | 44                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 16                                    |
| 52                | 1 615             | 141.3  | 142.6 | 241                   | 1 383                      | 1 328.7                     | 1 429                | 1 517.6              | 48                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 16                                    |
| 54                | 1 675             | 135.0  | 147.7 | 238                   | 1 435                      | 1 379.5                     | 1 480                | 1 578.0              | 48                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 16                                    |
| 56                | 1 765             | 152.4  | 155.4 | 267                   | 1 494                      | 1 430.3                     | 1 537                | 1 651.0              | 36                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 17                                    |
| 58                | 1 825             | 152.4  | 160.4 | 273                   | 1 548                      | 1 481.1                     | 1 594                | 1 712.9              | 40                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 17                                    |
| 60                | 1 880             | 149.3  | 165.1 | 270                   | 1 599                      | 1 531.9                     | 1 651                | 1 763.7              | 40                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 17                                    |

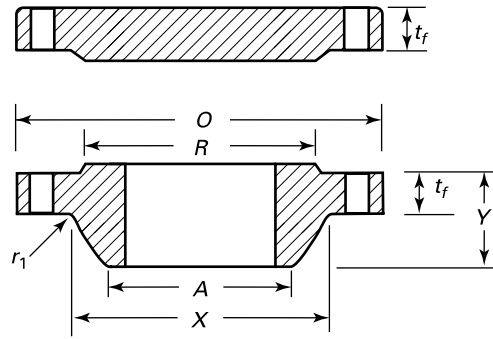
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table 39 Dimensions of Class 400 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                         | Minimum Fillet Radius, $r_1$ |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------|------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in. |                              | Diam. of Bolt, in. |
| 26                | 850                 | 88.9  | 88.9  | 149                     | 689                          | 660.4                         | 711                    | 781.0                | 28                | 1½                      | 1¾                           | 11                 |
| 28                | 915                 | 95.3  | 95.3  | 159                     | 740                          | 711.2                         | 762                    | 838.2                | 24                | 1⅝                      | 1½                           | 13                 |
| 30                | 970                 | 101.6   | 101.6 | 170                     | 794                          | 762.0                         | 819                    | 895.4                | 28                | 1⅝                      | 1½                           | 13                 |
| 32                | 1 035               | 108.0   | 108.0 | 179                     | 845                          | 812.8                         | 873                    | 952.5                | 28                | 1¾                      | 1⅝                           | 13                 |
| 34                | 1 085               | 111.2   | 111.2 | 187                     | 899                          | 863.6                         | 927                    | 1 003.3              | 32                | 1¾                      | 1⅝                           | 14                 |
| 36                | 1 155               | 119.1   | 119.1 | 200                     | 952                          | 914.4                         | 981                    | 1 066.8              | 28                | 1⅞                      | 1¾                           | 14                 |
| 38                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 40                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 42                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 44                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 46                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 48                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                     | ...                          | ...                |

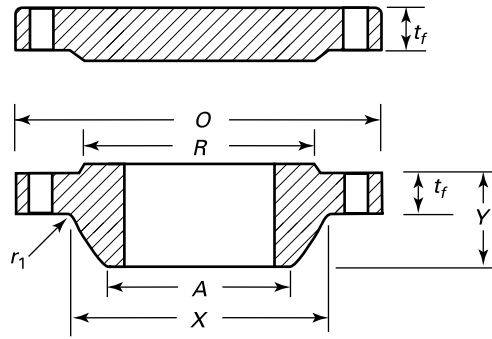
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table 40 Dimensions of Class 600 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, O | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, Y | Diam. of Hub, X [Note (2)] | Hub Diam. Top, A [Note (3)] | Raised Face Diam., R | Drilling             |                   |                               | Diam. of Bolt, in.            | Minimum Fillet Radius, $r_1$ |
|-------------------|-------------------|---|-------|-----------------------|----------------------------|-----------------------------|----------------------|----------------------|-------------------|-------------------------------|-------------------------------|------------------------------|
|                   |                   | WNF   | Blind |                       |                            |                             |                      | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               |                              |
| 26                | 890               | 111.2   | 111.3 | 181                   | 698                        | 660.4                       | 727                  | 806.4                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub> | 13                           |
| 28                | 950               | 115.9   | 115.9 | 190                   | 752                        | 711.2                       | 784                  | 863.6                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 13                           |
| 30                | 1 020             | 125.5   | 127.0 | 205                   | 806                        | 762.0                       | 841                  | 927.1                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 13                           |
| 32                | 1 085             | 130.2   | 134.9 | 216                   | 860                        | 812.8                       | 895                  | 984.2                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 13                           |
| 34                | 1 160             | 141.3   | 144.2 | 233                   | 914                        | 863.6                       | 953                  | 1 054.1              | 24                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 14                           |
| 36                | 1 215             | 146.1   | 150.9 | 243                   | 968                        | 914.4                       | 1 010                | 1 104.9              | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 14                           |
| 38                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 40                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 42                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 44                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 46                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 48                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 50                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 52                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 54                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 56                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 58                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |
| 60                | ...               | ...   | ...   | ...                   | ...                        | ...                         | ...                  | ...                  | ...               | ...                           | ...                           | ...                          |

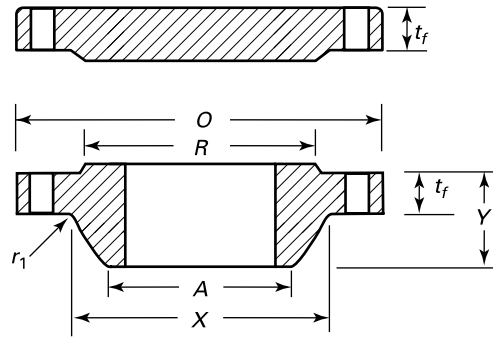
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table 41 Dimensions of Class 900 Series B Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |                    |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|--------------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole, in.       |                               | Diam. of Bolt, in. |
| 26                | 1 020               | 135.0   | 154.0 | 259                     | 743                          | 660.4                         | 762                    | 901.7                | 20                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 11                 |
| 28                | 1 105               | 147.7   | 166.7 | 276                     | 797                          | 711.2                         | 819                    | 971.6                | 20                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub> | 13                 |
| 30                | 1 180               | 155.6   | 176.1 | 289                     | 851                          | 762.0                         | 876                    | 1 035.0              | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 13                 |
| 32                | 1 240               | 160.4   | 186.0 | 303                     | 908                          | 812.8                         | 927                    | 1 092.2              | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 13                 |
| 34                | 1 315               | 171.5   | 195.0 | 319                     | 962                          | 863.6                         | 991                    | 1 155.7              | 20                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 14                 |
| 36                | 1 345               | 173.1   | 201.7 | 325                     | 1 016                        | 914.4                         | 1 029                  | 1 200.2              | 24                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 14                 |
| 38                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 40                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 42                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 44                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 46                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 48                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...                |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For sport facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.



(17)

**Table 42 Flange Bolting Dimensional Recommendations**

| <b>Product</b>                                  | <b>Carbon Steel</b>                    | <b>Alloy Steel</b>  |
|---|--|---|
| Bolts smaller than $\frac{3}{4}$ in.            | ASME B18.2.1, square or heavy hex head | ASME B18.2.1, heavy hex head  |
| Bolts equal to or larger than $\frac{3}{4}$ in. | ASME B18.2.1, square or heavy hex head | ASME B18.2.1, heavy hex head  |
| Nuts smaller than $\frac{3}{4}$ in.             | ASME B18.2.2, heavy hex                | ASME B18.2.2, heavy hex   |
| Nuts equal to or larger than $\frac{3}{4}$ in.  | ASME B18.2.2, hex or heavy hex         | ASME B18.2.2, heavy hex   |
| Stud bolts                                      | ASME B18.31.2                          | ASME B18.31.2   |
| External threads                                | ASME B1.1, Cl. 2A course series        | ASME B1.1, Cl. 2A course series up through 1 in.;<br>eight thread series for larger bolts |
| Internal threads                                | ASME B1.1, Cl. 2B course series        | ASME B1.1, Cl. 2B course series up through 1 in.;<br>eight thread series for larger bolts |

# MANDATORY APPENDIX I

## PRESSURE-TEMPERATURE RATINGS AND DIMENSIONAL DATA FOR CLASSES 75, 150, 300, 400, 600, AND 900 FLANGES IN U.S. CUSTOMARY UNITS

The pressure-temperature ratings for the materials listed in [Table 1](#), and covered by this Standard are as listed in [Tables 3 through 28](#) and [Tables I-1 through I-26](#) of [Mandatory Appendix I](#).

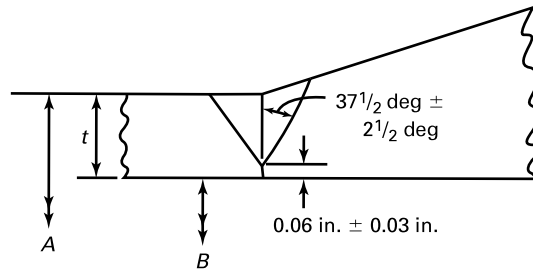
[Tables 3 through 28](#) have pressure-temperature ratings using bar units for pressure (1 bar = 100 kPa) and degrees Celsius units for temperature.

[Tables I-1 through I-26](#) of [Mandatory Appendix I](#) have coterminous pressure-temperature ratings using pounds per square inch (psi) units for pressure and degrees Fahrenheit units for temperature.

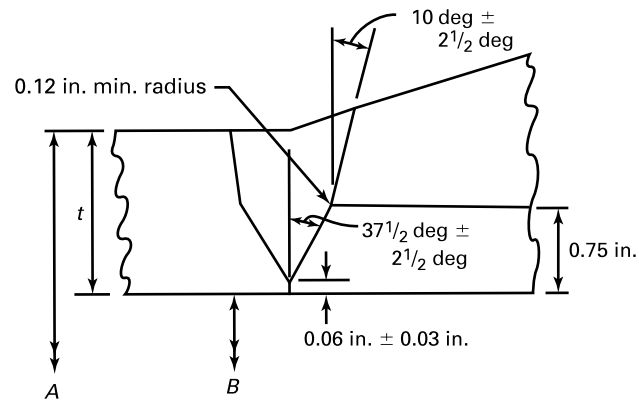
All tabulated pressures are gage pressures.

[Figures I-1 through I-3](#) and [Tables I-27 through I-39](#) included in this Mandatory Appendix provide dimensional data in U.S. Customary units for Classes 75, 150, 300, 400, 600, and 900 flanges.

**Figure I-1 Welding Ends (Welding Neck Flanges, No Backing Rings)**



**(a) Bevel for Wall Thickness,  $t$   
From 0.19 in. to 0.88 in. Inclusive**



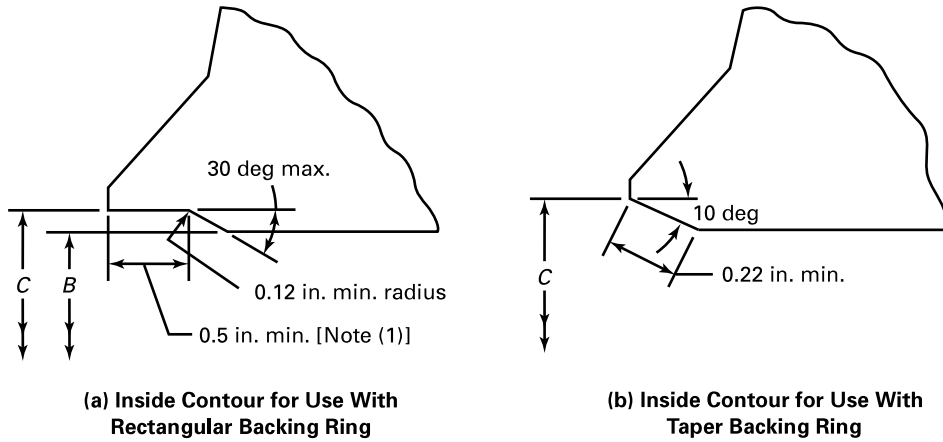
**(b) Bevel for Wall Thickness,  $t$   
Greater Than 0.88 in.**

$A$  = nominal outside diameter of pipe  
 $B$  = nominal inside diameter of pipe  
 $t$  = nominal wall thickness of pipe

**GENERAL NOTES:**

- (a) See [paras. 6.4](#) and [7.4](#) for details and tolerances.
- (b) See [Figure I-2](#) for additional details of welding ends.
- (c) When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined, the additional thickness may be provided on either the inside, or outside, or partially on each side, but the total additional thickness shall not exceed  $\frac{1}{2}$  times the nominal wall thickness of the mating pipe (see [Figure I-3](#)).

**Figure I-2 Welding Ends (Welding Neck Flanges With Backing Rings)**



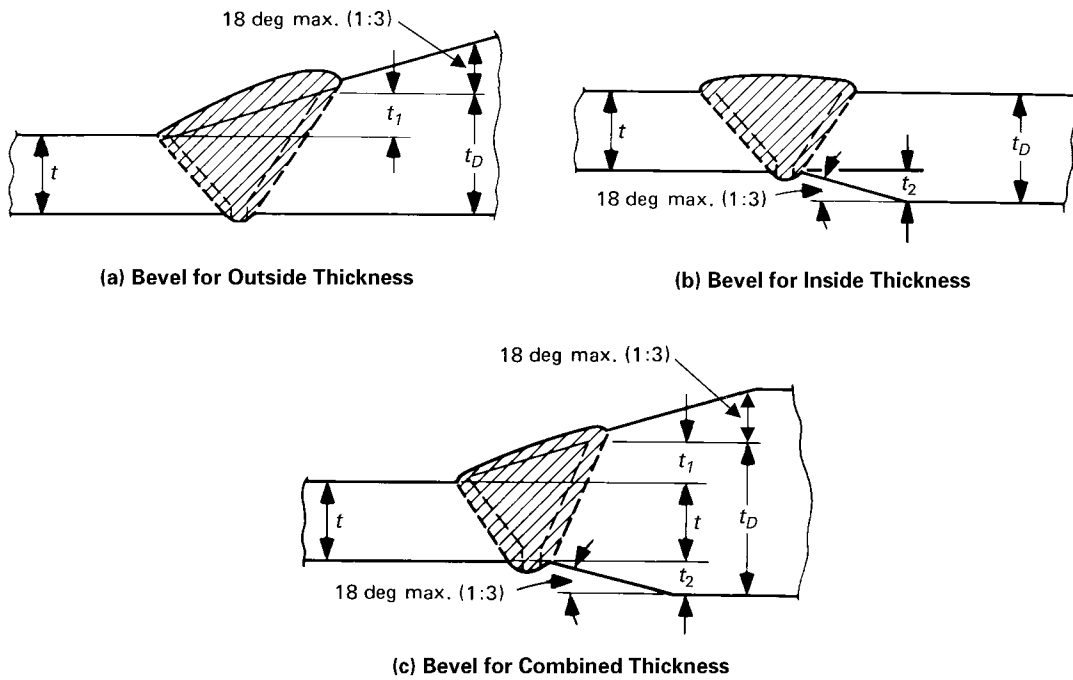
- $A$  = nominal outside diameter of welding end, in.
- $B$  = nominal inside diameter of pipe  
=  $A - 2t$ , in.
- $C = A - 0.031$  in. -  $1.75t - 0.010$  in.
- $t$  = nominal wall thickness of pipe, in.
- $1.75t = 87\frac{1}{2}\%$  of nominal wall multiplied by two to convert into terms of diameter
- 0.010 in. = plus tolerance on diameter  $C$ , in. (see [para 7.4.3](#))
- 0.031 in. = minus tolerance on O.D. of pipe, in.

GENERAL NOTES:

- (a) See [paras. 6.4](#) and [7.4](#) for details and tolerances.
- (b) See [Figure I-1](#) for welding and details of welding neck flanges.

NOTE: (1) 0.5 in. depth based on the use of a 0.75 in. wide backing ring.

**Figure I-3 Welding Ends (Welding Neck Flanges)**



**GENERAL NOTES:**

- (a) Neither  $t_1$ ,  $t_2$ , nor their sum ( $t_1 + t_2$ ) shall exceed  $0.5t$ .
- (b) When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal  $t$  times the ratio of minimum specified yield strength of the pipe to the minimum specified yield strength of the flange.
- (c) Welding shall be in accordance with the applicable code.
- (d) Additional thickness for welding to higher strength pipe.

**Table I-1 Pressure-Temperature Ratings for Group 1.1 Materials**

| Nominal Designation                      | Forgings                      |     | Castings                |     | Plates                       |       |
|--|-------------------------------|-----|-------------------------|-----|------------------------------|-------|
|  |                               |     |                         |     |                              |       |
| C-Si                                     | A105 [Note (1)]               |     | A216 Gr. WCB [Note (1)] |     | A515 Gr. 70 [Note (1)]       |       |
| C-Mn-Si                                  | A350 Gr. LF2 [Note (1)]       |     | ...                     |     | A516 Gr. 70 [Notes (1), (2)] |       |
| C-Mn-Si                                  | ...                           |     | ...                     |     | A537 Cl. 1 [Note (3)]        |       |
| C-Mn-Si-V                                | A350 Gr. LF6 Cl. 1 [Note (4)] |     | ...                     |     | ...                          |       |
| 3½Ni                                     | A350 Gr. LF3                  |     | ...                     |     | ...                          |       |
| <b>Working Pressure by Classes, psig</b> |                               |     |                         |     |                              |       |
| Temperature, °F                          | 75                            | 150 | 300                     | 400 | 600                          | 900   |
| -20 to 100                               | 140                           | 285 | 740                     | 985 | 1,480                        | 2,220 |
| 200                                      | 130                           | 260 | 680                     | 905 | 1,360                        | 2,035 |
| 300                                      | 115                           | 230 | 655                     | 870 | 1,310                        | 1,965 |
| 400                                      | 100                           | 200 | 635                     | 845 | 1,265                        | 1,900 |
| 500                                      | 85                            | 170 | 605                     | 805 | 1,205                        | 1,810 |
| 600                                      | 70                            | 140 | 570                     | 755 | 1,135                        | 1,705 |
| 650                                      | 60                            | 125 | 550                     | 730 | 1,100                        | 1,650 |
| 700                                      | ...                           | 110 | 530                     | 710 | 1,060                        | 1,590 |
| 750                                      | ...                           | 95  | 505                     | 675 | 1,015                        | 1,520 |
| 800                                      | ...                           | 80  | 410                     | 550 | 825                          | 1,235 |
| 850                                      | ...                           | 65  | 320                     | 425 | 640                          | 955   |
| 900                                      | ...                           | 50  | 230                     | 305 | 460                          | 690   |
| 950                                      | ...                           | 35  | 135                     | 185 | 275                          | 410   |
| 1,000                                    | ...                           | 20  | 85                      | 115 | 170                          | 255   |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 850°F.
- (3) Not to be used over 700°F.
- (4) Not to be used over 500°F.

**Table I-2 Pressure-Temperature Ratings for Group 1.2 Materials**

| Nominal Designation                      | Forgings                      |     | Castings                |       | Plates                |       |
|--|-------------------------------|-----|-------------------------|-------|-----------------------|-------|
|  |                               |     |                         |       |                       |       |
| C-Mn-Si                                  | ...                           |     | A216 Gr. WCC [Note (1)] |       |                       | ...   |
| C-Mn-Si                                  | ...                           |     | A352 Gr. LCC [Note (2)] |       |                       | ...   |
| C-Mn-Si-V                                | A350 Gr. LF6 Cl. 2 [Note (3)] |     | ...                     |       |                       | ...   |
| 2½Ni                                     | ...                           |     | A352 Gr. LC2            |       | A203 Gr. B [Note (1)] |       |
| 3½Ni                                     | ...                           |     | A352 Gr. LC3 [Note (2)] |       | A203 Gr. E [Note (1)] |       |
| <b>Working Pressure by Classes, psig</b> |                               |     |                         |       |                       |       |
| Temperature, °F                          | 75                            | 150 | 300                     | 400   | 600                   | 900   |
| -20 to 100                               | 145                           | 290 | 750                     | 1,000 | 1,500                 | 2,250 |
| 200                                      | 130                           | 260 | 750                     | 1,000 | 1,500                 | 2,250 |
| 300                                      | 115                           | 230 | 730                     | 970   | 1,455                 | 2,185 |
| 400                                      | 100                           | 200 | 705                     | 940   | 1,405                 | 2,110 |
| 500                                      | 85                            | 170 | 665                     | 885   | 1,330                 | 1,995 |
| 600                                      | 70                            | 140 | 605                     | 805   | 1,210                 | 1,815 |
| 650                                      | 60                            | 125 | 590                     | 785   | 1,175                 | 1,765 |
| 700                                      | ...                           | 110 | 555                     | 740   | 1,110                 | 1,665 |
| 750                                      | ...                           | 95  | 505                     | 675   | 1,015                 | 1,520 |
| 800                                      | ...                           | 80  | 410                     | 550   | 825                   | 1,235 |
| 850                                      | ...                           | 65  | 320                     | 425   | 640                   | 955   |
| 900                                      | ...                           | 50  | 225                     | 295   | 445                   | 670   |
| 950                                      | ...                           | 35  | 135                     | 185   | 275                   | 410   |
| 1,000                                    | ...                           | 20  | 85                      | 115   | 170                   | 255   |

NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 650°F.
- (3) Not to be used over 500°F.

**Table I-3 Pressure-Temperature Ratings for Group 1.3 Materials**

| Nominal Designation                      | Forgings |                              | Castings |     | Plates                       |       |
|--|----------|------------------------------|----------|-----|------------------------------|-------|
|  |          |                              |          |     |                              |       |
| C-Si                                     | ...      | A352 Gr. LCB [Note (1)]      |          |     | A515 Gr. 65 [Note (2)]       |       |
| C-Mn-Si                                  | ...      |                              | ...      |     | A516 Gr. 65 [Notes (2), (3)] |       |
| C- $\frac{1}{2}$ Mo                      | ...      | A217 Gr. WC1 [Notes (4)-(6)] |          |     |                              | ...   |
| C- $\frac{1}{2}$ Mo                      | ...      | A352 Gr. LC1 [Note (1)]      |          |     |                              | ...   |
| 2 $\frac{1}{2}$ Ni                       | ...      |                              | ...      |     | A203 Gr. A [Note (2)]        |       |
| 3 $\frac{1}{2}$ Ni                       | ...      |                              | ...      |     | A203 Gr. D [Note (2)]        |       |
| <b>Working Pressure by Classes, psig</b> |          |                              |          |     |                              |       |
| Temperature, °F                          | 75       | 150                          | 300      | 400 | 600                          | 900   |
| -20 to 100                               | 135      | 265                          | 695      | 930 | 1,395                        | 2,090 |
| 200                                      | 125      | 255                          | 660      | 880 | 1,320                        | 1,980 |
| 300                                      | 115      | 230                          | 640      | 850 | 1,275                        | 1,915 |
| 400                                      | 100      | 200                          | 615      | 820 | 1,230                        | 1,845 |
| 500                                      | 85       | 170                          | 585      | 780 | 1,175                        | 1,760 |
| 600                                      | 70       | 140                          | 550      | 735 | 1,105                        | 1,655 |
| 650                                      | 60       | 125                          | 535      | 710 | 1,065                        | 1,600 |
| 700                                      | ...      | 110                          | 510      | 685 | 1,025                        | 1,535 |
| 750                                      | ...      | 95                           | 475      | 635 | 955                          | 1,430 |
| 800                                      | ...      | 80                           | 390      | 520 | 780                          | 1,175 |
| 850                                      | ...      | 65                           | 300      | 400 | 595                          | 895   |
| 900                                      | ...      | 50                           | 200      | 270 | 405                          | 605   |
| 950                                      | ...      | 35                           | 135      | 185 | 275                          | 410   |
| 1,000                                    | ...      | 20                           | 85       | 115 | 170                          | 255   |

## NOTES:

- (1) Not to be used over 650°F.
- (2) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (3) Not to be used over 850°F.
- (4) Upon prolonged exposure to temperatures above 875°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.
- (5) Use normalized and tempered material only.
- (6) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.



**Table I-4 Pressure-Temperature Ratings for Group 1.4 Materials**

| Nominal Designation | Forgings                                 |     | Castings |     | Plates                       |       |
|---------------------|--|-----|----------|-----|------------------------------|-------|
|                     |  |     |          |     |                              |       |
| C-Si                | ...                                      |     | ...      |     | A515 Gr. 60 [Note (1)]       |       |
| C-Mn-Si             | A350 Gr. LF1 Cl. 1 [Note (1)]            |     | ...      |     | A516 Gr. 60 [Notes (1), (2)] |       |
|                     | <b>Working Pressure by Classes, psig</b> |     |          |     |                              |       |
| Temperature, °F     | 75                                       | 150 | 300      | 400 | 600                          | 900   |
| -20 to 100          | 120                                      | 235 | 615      | 825 | 1,235                        | 1,850 |
| 200                 | 110                                      | 215 | 565      | 755 | 1,130                        | 1,695 |
| 300                 | 105                                      | 210 | 545      | 725 | 1,090                        | 1,635 |
| 400                 | 100                                      | 200 | 525      | 700 | 1,055                        | 1,580 |
| 500                 | 85                                       | 170 | 500      | 670 | 1,005                        | 1,505 |
| 600                 | 70                                       | 140 | 475      | 630 | 945                          | 1,420 |
| 650                 | 60                                       | 125 | 455      | 610 | 915                          | 1,370 |
| 700                 | ...                                      | 110 | 440      | 590 | 885                          | 1,325 |
| 750                 | ...                                      | 95  | 430      | 570 | 855                          | 1,285 |
| 800                 | ...                                      | 80  | 370      | 495 | 740                          | 1,110 |
| 850                 | ...                                      | 65  | 300      | 400 | 595                          | 895   |
| 900                 | ...                                      | 50  | 170      | 230 | 345                          | 515   |
| 950                 | ...                                      | 35  | 135      | 185 | 275                          | 410   |
| 1,000               | ...                                      | 20  | 85       | 115 | 170                          | 255   |

## NOTES:

- (1) Upon prolonged exposure to temperature above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 850°F.

**Table I-5 Pressure-Temperature Ratings for Group 1.5 Materials**

| Nominal Designation                      | Forgings               |     | Castings |     | Plates                |       |
|--|------------------------|-----|----------|-----|-----------------------|-------|
|  |                        |     |          |     |                       |       |
| C- $\frac{1}{2}$ Mo                      | A182 Gr. F1 [Note (1)] |     | ...      |     | A204 Gr. A [Note (1)] |       |
| C- $\frac{1}{2}$ Mo                      | ...                    |     | ...      |     | A204 Gr. B [Note (1)] |       |
| <b>Working Pressure by Classes, psig</b> |                        |     |          |     |                       |       |
| Temperature, °F                          | 75                     | 150 | 300      | 400 | 600                   | 900   |
| -20 to 100                               | 135                    | 265 | 695      | 930 | 1,395                 | 2,090 |
| 200                                      | 130                    | 260 | 695      | 930 | 1,395                 | 2,090 |
| 300                                      | 115                    | 230 | 685      | 915 | 1,375                 | 2,060 |
| 400                                      | 100                    | 200 | 660      | 885 | 1,325                 | 1,985 |
| 500                                      | 85                     | 170 | 640      | 855 | 1,285                 | 1,925 |
| 600                                      | 70                     | 140 | 605      | 805 | 1,210                 | 1,815 |
| 650                                      | 60                     | 125 | 590      | 785 | 1,175                 | 1,765 |
| 700                                      | ...                    | 110 | 570      | 755 | 1,135                 | 1,705 |
| 750                                      | ...                    | 95  | 530      | 710 | 1,065                 | 1,595 |
| 800                                      | ...                    | 80  | 510      | 675 | 1,015                 | 1,525 |
| 850                                      | ...                    | 65  | 485      | 650 | 975                   | 1,460 |
| 900                                      | ...                    | 50  | 450      | 600 | 900                   | 1,350 |
| 950                                      | ...                    | 35  | 280      | 375 | 560                   | 845   |
| 1,000                                    | ...                    | 20  | 165      | 220 | 330                   | 495   |

NOTE: (1) Upon prolonged exposure to temperatures above 875°F, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.

**Table I-6 Pressure-Temperature Ratings for Group 1.7 Materials**

| Nominal Designation                                    | Forgings               |     | Castings                      |       |       | Plates |
|--|------------------------|-----|-------------------------------|-------|-------|--------|
|  |                        |     |                               |       |       |        |
| $\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$            | A182 Gr. F2 [Note (1)] |     | ...                           |       |       | ...    |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$  | ...                    |     | A217 Gr. WC4 [Notes (1)-(3)]  |       |       | ...    |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ | ...                    |     | A217 Gr. WC5 [Notes (2), (3)] |       |       | ...    |
| Working Pressure by Classes, psig                      |                        |     |                               |       |       |        |
| Temperature, °F  | 75                     | 150 | 300                           | 400   | 600   | 900    |
| -20 to 100   | 145                    | 290 | 750                           | 1,000 | 1,500 | 2,250  |
| 200  | 130                    | 260 | 750                           | 1,000 | 1,500 | 2,250  |
| 300  | 115                    | 230 | 730                           | 970   | 1,455 | 2,185  |
| 400  | 100                    | 200 | 705                           | 940   | 1,410 | 2,115  |
| 500  | 85                     | 170 | 665                           | 885   | 1,330 | 1,995  |
| 600  | 70                     | 140 | 605                           | 805   | 1,210 | 1,815  |
| 650  | 60                     | 125 | 590                           | 785   | 1,175 | 1,765  |
| 700  | ...                    | 110 | 570                           | 755   | 1,135 | 1,705  |
| 750  | ...                    | 95  | 530                           | 710   | 1,065 | 1,595  |
| 800  | ...                    | 80  | 510                           | 675   | 1,015 | 1,525  |
| 850  | ...                    | 65  | 485                           | 650   | 975   | 1,460  |
| 900  | ...                    | 50  | 450                           | 600   | 900   | 1,350  |
| 950  | ...                    | 35  | 315                           | 420   | 630   | 945    |
| 1,000  | ...                    | 20  | 200                           | 270   | 405   | 605    |
| 1,050  | ...                    | ... | 160                           | 210   | 315   | 475    |

## NOTES:

- (1) Not to be used over 1,000°F.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

Table I-7 Pressure-Temperature Ratings for Group 1.9 Materials

| Nominal Designation                     | Forgings                            |     | Castings                           |       | Plates                       |       |
|---|-------------------------------------|-----|------------------------------------|-------|------------------------------|-------|
|   | Working Pressure by Classes, psig   |     |                                    |       |                              |       |
| Temperature, °F                         | 75                                  | 150 | 300                                | 400   | 600                          | 900   |
| 1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo    | ...                                 | ... | A217 Gr. WC6 [Notes (1), (3), (4)] |       | ...                          | ...   |
| 1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo-Si | A182 Gr. F11 Cl. 2 [Notes (1), (2)] |     | ...                                | ...   | A387 Gr. 11 Cl. 2 [Note (2)] |       |
| -20 to 100                              | 145                                 | 290 | 750                                | 1,000 | 1,500                        | 2,250 |
| 200                                     | 130                                 | 260 | 750                                | 1,000 | 1,500                        | 2,250 |
| 300                                     | 115                                 | 230 | 720                                | 965   | 1,445                        | 2,165 |
| 400                                     | 100                                 | 200 | 695                                | 925   | 1,385                        | 2,080 |
| 500                                     | 85                                  | 170 | 665                                | 885   | 1,330                        | 1,995 |
| 600                                     | 70                                  | 140 | 605                                | 805   | 1,210                        | 1,815 |
| 650                                     | 60                                  | 125 | 590                                | 785   | 1,175                        | 1,765 |
| 700                                     | ...                                 | 110 | 570                                | 755   | 1,135                        | 1,705 |
| 750                                     | ...                                 | 95  | 530                                | 710   | 1,065                        | 1,595 |
| 800                                     | ...                                 | 80  | 510                                | 675   | 1,015                        | 1,525 |
| 850                                     | ...                                 | 65  | 485                                | 650   | 975                          | 1,460 |
| 900                                     | ...                                 | 50  | 450                                | 600   | 900                          | 1,350 |
| 950                                     | ...                                 | 35  | 320                                | 425   | 640                          | 955   |
| 1,000                                   | ...                                 | 20  | 215                                | 290   | 430                          | 650   |
| 1,050                                   | ...                                 | ... | 145                                | 190   | 290                          | 430   |
| 1,100                                   | ...                                 | ... | 95                                 | 130   | 190                          | 290   |
| 1,150                                   | ...                                 | ... | 65                                 | 85    | 130                          | 195   |
| 1,200                                   | ...                                 | ... | 40                                 | 55    | 80                           | 125   |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 1,100°F.
- (3) Not to be used over 1,100°F.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table I-8 Pressure–Temperature Ratings for Group 1.10 Materials**

| Nominal Designation | Forgings                          |     | Castings                           |       | Plates                       |       |
|---------------------|-----------------------------------|-----|------------------------------------|-------|------------------------------|-------|
|                     | A182 Gr. F22 Cl. 3 [Note (1)]     |     | A217 Gr. WC9 [Notes (2), (3), (4)] |       | A387 Gr. 22 Cl. 2 [Note (1)] |       |
| Temperature, °F     | Working Pressure by Classes, psig |     |                                    |       |                              |       |
|                     | 75                                | 150 | 300                                | 400   | 600                          | 900   |
| -20 to 100          | 145                               | 290 | 750                                | 1,000 | 1,500                        | 2,250 |
| 200                 | 130                               | 260 | 750                                | 1,000 | 1,500                        | 2,250 |
| 300                 | 115                               | 230 | 730                                | 970   | 1,455                        | 2,185 |
| 400                 | 100                               | 200 | 705                                | 940   | 1,410                        | 2,115 |
| 500                 | 85                                | 170 | 665                                | 885   | 1,330                        | 1,995 |
| 600                 | 70                                | 140 | 605                                | 805   | 1,210                        | 1,815 |
| 650                 | 60                                | 125 | 590                                | 785   | 1,175                        | 1,765 |
| 700                 | ...                               | 110 | 570                                | 755   | 1,135                        | 1,705 |
| 750                 | ...                               | 95  | 530                                | 710   | 1,065                        | 1,595 |
| 800                 | ...                               | 80  | 510                                | 675   | 1,015                        | 1,525 |
| 850                 | ...                               | 65  | 485                                | 650   | 975                          | 1,460 |
| 900                 | ...                               | 50  | 450                                | 600   | 900                          | 1,350 |
| 950                 | ...                               | 35  | 385                                | 515   | 755                          | 1,160 |
| 1,000               | ...                               | 20  | 265                                | 355   | 535                          | 800   |
| 1,050               | ...                               | ... | 175                                | 235   | 350                          | 525   |
| 1,100               | ...                               | ... | 110                                | 145   | 220                          | 330   |
| 1,150               | ...                               | ... | 70                                 | 90    | 135                          | 205   |
| 1,200               | ...                               | ... | 40                                 | 55    | 80                           | 125   |

NOTES:

- (1) Permissible, but not recommended for prolonged use above 1,100°F.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 1,100°F.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table I-9 Pressure–Temperature Ratings for Group 1.11 Materials**

| Nominal Designation | Forgings                          |     | Castings |       | Plates                |       |
|---------------------|-----------------------------------|-----|----------|-------|-----------------------|-------|
|                     | Working Pressure by Classes, psig |     |          |       |                       |       |
| Temperature, °F     | 75                                | 150 | 300      | 400   | 600                   | 900   |
| C- $\frac{1}{2}$ Mo | ...                               | ... | ...      | ...   | A204 Gr. C [Note (1)] |       |
| -20 to 100          | 145                               | 290 | 750      | 1,000 | 1,500                 | 2,250 |
| 200                 | 130                               | 260 | 750      | 1,000 | 1,500                 | 2,250 |
| 300                 | 115                               | 230 | 730      | 970   | 1,455                 | 2,185 |
| 400                 | 100                               | 200 | 705      | 940   | 1,410                 | 2,115 |
| 500                 | 85                                | 170 | 665      | 885   | 1,330                 | 1,995 |
| 600                 | 70                                | 140 | 605      | 805   | 1,210                 | 1,815 |
| 650                 | 60                                | 125 | 590      | 785   | 1,175                 | 1,765 |
| 700                 | ...                               | 110 | 570      | 755   | 1,135                 | 1,705 |
| 750                 | ...                               | 95  | 530      | 710   | 1,065                 | 1,595 |
| 800                 | ...                               | 80  | 510      | 675   | 1,015                 | 1,525 |
| 850                 | ...                               | 65  | 485      | 650   | 975                   | 1,460 |
| 900                 | ...                               | 50  | 450      | 600   | 900                   | 1,345 |
| 950                 | ...                               | 35  | 280      | 375   | 560                   | 845   |
| 1,000               | ...                               | 20  | 165      | 220   | 330                   | 495   |
| 1,050               | ...                               | ... | 165      | 220   | 330                   | 495   |
| 1,100               | ...                               | ... | 110      | 145   | 220                   | 330   |
| 1,150               | ...                               | ... | 80       | 110   | 165                   | 245   |
| 1,200               | ...                               | ... | 45       | 60    | 90                    | 135   |

NOTE: (1) Upon prolonged exposure to temperatures above 875°F, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.

**Table I-10 Pressure-Temperature Ratings for Group 1.13 Materials**

| Nominal Designation | Forgings                          |     | Castings                     |       |       | Plates |
|---------------------|-----------------------------------|-----|------------------------------|-------|-------|--------|
|                     | A182 Gr. F5a                      |     | A217 Gr. C5 [Notes (1), (2)] |       |       | ...    |
| Temperature, °F     | Working Pressure by Classes, psig |     |                              |       |       |        |
|                     | 75                                | 150 | 300                          | 400   | 600   | 900    |
| -20 to 100          | 145                               | 290 | 750                          | 1,000 | 1,500 | 2,250  |
| 200                 | 130                               | 260 | 750                          | 1,000 | 1,500 | 2,250  |
| 300                 | 115                               | 230 | 730                          | 970   | 1,455 | 2,185  |
| 400                 | 100                               | 200 | 705                          | 940   | 1,410 | 2,115  |
| 500                 | 85                                | 170 | 665                          | 885   | 1,330 | 1,995  |
| 600                 | 70                                | 140 | 605                          | 805   | 1,210 | 1,815  |
| 650                 | 60                                | 125 | 590                          | 785   | 1,175 | 1,765  |
| 700                 | ...                               | 110 | 570                          | 755   | 1,135 | 1,705  |
| 750                 | ...                               | 95  | 530                          | 710   | 1,065 | 1,595  |
| 800                 | ...                               | 80  | 510                          | 675   | 1,015 | 1,525  |
| 850                 | ...                               | 65  | 485                          | 650   | 975   | 1,460  |
| 900                 | ...                               | 50  | 375                          | 500   | 745   | 1,120  |
| 950                 | ...                               | 35  | 275                          | 365   | 550   | 825    |
| 1,000               | ...                               | 20  | 200                          | 265   | 400   | 595    |
| 1,050               | ...                               | ... | 145                          | 190   | 290   | 430    |
| 1,100               | ...                               | ... | 100                          | 135   | 200   | 300    |
| 1,150               | ...                               | ... | 60                           | 80    | 125   | 185    |
| 1,200               | ...                               | ... | 35                           | 45    | 70    | 105    |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table I-11 Pressure–Temperature Ratings for Group 1.14 Materials**

| Nominal Designation | Forgings                         |     | Castings                      |       |       | Plates |
|---------------------|----------------------------------|-----|-------------------------------|-------|-------|--------|
|                     | A182 Gr. F9                      |     | A217 Gr. C12 [Notes (1), (2)] |       |       | ...    |
| Temperature, °F     | Working Pressure by Classes, psi |     |                               |       |       |        |
|                     | 75                               | 150 | 300                           | 400   | 600   | 900    |
| -20 to 100          | 145                              | 290 | 750                           | 1,000 | 1,500 | 2,250  |
| 200                 | 130                              | 260 | 750                           | 1,000 | 1,500 | 2,250  |
| 300                 | 115                              | 230 | 730                           | 970   | 1,455 | 2,185  |
| 400                 | 100                              | 200 | 705                           | 940   | 1,410 | 2,115  |
| 500                 | 85                               | 170 | 665                           | 885   | 1,330 | 1,995  |
| 600                 | 70                               | 140 | 605                           | 805   | 1,210 | 1,815  |
| 650                 | 60                               | 125 | 590                           | 785   | 1,175 | 1,765  |
| 700                 | ...                              | 110 | 570                           | 755   | 1,135 | 1,705  |
| 750                 | ...                              | 95  | 530                           | 710   | 1,065 | 1,595  |
| 800                 | ...                              | 80  | 510                           | 675   | 1,015 | 1,525  |
| 850                 | ...                              | 65  | 485                           | 650   | 975   | 1,460  |
| 900                 | ...                              | 50  | 450                           | 600   | 900   | 1,350  |
| 950                 | ...                              | 35  | 375                           | 505   | 755   | 1,130  |
| 1,000               | ...                              | 20  | 255                           | 340   | 505   | 760    |
| 1,050               | ...                              | ... | 170                           | 230   | 345   | 515    |
| 1,100               | ...                              | ... | 115                           | 150   | 225   | 340    |
| 1,150               | ...                              | ... | 75                            | 100   | 150   | 225    |
| 1,200               | ...                              | ... | 50                            | 70    | 105   | 155    |

## NOTE:

(1) Use normalized and tempered material only.

(2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.



**Table I-12 Pressure-Temperature Ratings for Group 1.15 Materials**

| Nominal Designation | Forgings                          |     | Castings                 |       | Plates            |       |
|---------------------|-----------------------------------|-----|--------------------------|-------|-------------------|-------|
|                     | A182 Gr. F91                      |     | A217 Gr. C12A [Note (1)] |       | A387 Gr. 91 Cl. 2 |       |
| Temperature, °F     | Working Pressure by Classes, psig |     |                          |       |                   |       |
|                     | 75                                | 150 | 300                      | 400   | 600               | 900   |
| -20 to 100          | 145                               | 290 | 750                      | 1,000 | 1,500             | 2,250 |
| 200                 | 130                               | 260 | 750                      | 1,000 | 1,500             | 2,250 |
| 300                 | 115                               | 230 | 730                      | 970   | 1,455             | 2,185 |
| 400                 | 100                               | 200 | 705                      | 940   | 1,410             | 2,115 |
| 500                 | 85                                | 170 | 665                      | 885   | 1,330             | 1,995 |
| 600                 | 70                                | 140 | 605                      | 805   | 1,210             | 1,815 |
| 650                 | 60                                | 125 | 590                      | 785   | 1,175             | 1,765 |
| 700                 | ...                               | 110 | 570                      | 755   | 1,135             | 1,705 |
| 750                 | ...                               | 95  | 530                      | 710   | 1,065             | 1,595 |
| 800                 | ...                               | 80  | 510                      | 675   | 1,015             | 1,525 |
| 850                 | ...                               | 65  | 485                      | 650   | 975               | 1,460 |
| 900                 | ...                               | 50  | 450                      | 600   | 900               | 1,350 |
| 950                 | ...                               | 35  | 385                      | 515   | 775               | 1,160 |
| 1,000               | ...                               | 20  | 365                      | 485   | 725               | 1,090 |
| 1,050               | ...                               | 20  | 360                      | 480   | 720               | 1,080 |
| 1,100               | ...                               | ... | 300                      | 400   | 605               | 905   |
| 1,150               | ...                               | ... | 225                      | 295   | 445               | 670   |
| 1,200               | ...                               | ... | 145                      | 190   | 290               | 430   |

NOTE: (1) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

**Table I-13 Pressure-Temperature Ratings for Group 1.17 Materials**

| Nominal Designation               | Forgings                            |             | Castings |       | Plates |       |  |
|-----------------------------------|-------------------------------------|-------------|----------|-------|--------|-------|--|
|                                   | A182 Gr. F12 Cl. 2 [Notes (1), (2)] |             | ...      |       | ...    |       |  |
| 5Cr- $\frac{1}{2}$ Mo             |                                     | A182 Gr. F5 |          | ...   |        | ...   |  |
| Working Pressure by Classes, psig |                                     |             |          |       |        |       |  |
| Temperature, °F                   | 75                                  | 150         | 300      | 400   | 600    | 900   |  |
| -20 to 100                        | 145                                 | 290         | 750      | 1,000 | 1,500  | 2,250 |  |
| 200                               | 130                                 | 260         | 735      | 980   | 1,470  | 2,210 |  |
| 300                               | 115                                 | 230         | 700      | 935   | 1,400  | 2,100 |  |
| 400                               | 100                                 | 200         | 670      | 890   | 1,335  | 2,005 |  |
| 500                               | 85                                  | 170         | 645      | 860   | 1,290  | 1,940 |  |
| 600                               | 70                                  | 140         | 605      | 805   | 1,210  | 1,815 |  |
| 650                               | 60                                  | 125         | 590      | 785   | 1,175  | 1,765 |  |
| 700                               | ...                                 | 110         | 570      | 755   | 1,135  | 1,705 |  |
| 750                               | ...                                 | 95          | 530      | 710   | 1,065  | 1,595 |  |
| 800                               | ...                                 | 80          | 510      | 675   | 1,015  | 1,525 |  |
| 850                               | ...                                 | 65          | 485      | 650   | 975    | 1,460 |  |
| 900                               | ...                                 | 50          | 375      | 500   | 745    | 1,120 |  |
| 950                               | ...                                 | 35          | 275      | 365   | 550    | 825   |  |
| 1,000                             | ...                                 | 20          | 200      | 265   | 400    | 595   |  |
| 1,050                             | ...                                 | ...         | 145      | 190   | 290    | 430   |  |
| 1,100                             | ...                                 | ...         | 95       | 130   | 190    | 290   |  |
| 1,150                             | ...                                 | ...         | 60       | 80    | 125    | 185   |  |
| 1,200                             | ...                                 | ...         | 35       | 45    | 70     | 105   |  |

## NOTES:

(1) Use normalized and tempered material only.

(2) Permissible, but not recommended for prolonged use above 1,100°F.

(17)

**Table I-14 Pressure-Temperature Ratings for Group 1.18 Materials**

| Nominal Designation | Forgings                          |     |     | Castings |       | Plates |
|---------------------|-----------------------------------|-----|-----|----------|-------|--------|
|                     | A182 Gr. F92 [Note (1)]           |     |     | ...      |       | ...    |
| Temperature, °F     | Working Pressure by Classes, psig |     |     |          |       |        |
|                     | 75                                | 150 | 300 | 400      | 600   | 900    |
| -20 to 100          | 145                               | 290 | 750 | 1,000    | 1,500 | 2,250  |
| 200                 | 130                               | 260 | 750 | 1,000    | 1,500 | 2,250  |
| 300                 | 115                               | 230 | 730 | 970      | 1,455 | 2,185  |
| 400                 | 100                               | 200 | 705 | 940      | 1,410 | 2,115  |
| 500                 | 85                                | 170 | 665 | 885      | 1,330 | 1,995  |
| 600                 | 60                                | 140 | 605 | 805      | 1,210 | 1,815  |
| 650                 | ...                               | 125 | 590 | 785      | 1,175 | 1,765  |
| 700                 | ...                               | 110 | 570 | 755      | 1,135 | 1,705  |
| 750                 | ...                               | 95  | 530 | 710      | 1,065 | 1,595  |
| 800                 | ...                               | 80  | 510 | 675      | 1,015 | 1,525  |
| 850                 | ...                               | 65  | 485 | 650      | 975   | 1,460  |
| 900                 | ...                               | 50  | 450 | 600      | 900   | 1,350  |
| 950                 | ...                               | 35  | 385 | 515      | 775   | 1,160  |
| 1,000               | ...                               | 20  | 365 | 485      | 725   | 1,090  |
| 1,050               | ...                               | ... | 360 | 480      | 720   | 1,080  |
| 1,100               | ...                               | ... | 325 | 430      | 645   | 965    |
| 1,150               | ...                               | ... | 275 | 365      | 550   | 825    |
| 1,200               | ...                               | ... | 190 | 275      | 385   | 575    |

NOTE: (1) Applications above 1,150°F are limited to tubing of maximum outside diameter of 3½ in.

Table I-15 Pressure–Temperature Ratings for Group 2.1 Materials

| Nominal Designation               | Forgings                 |     | Castings                |     | Plates                  |       |
|-----------------------------------|--------------------------|-----|-------------------------|-----|-------------------------|-------|
|                                   |                          |     |                         |     |                         |       |
| 18Cr–8Ni                          | A182 Gr. F304 [Note (1)] |     | A351 Gr. CF3 [Note (2)] |     | A240 Gr. 304 [Note (1)] |       |
| 18Cr–8Ni                          | A182 Gr. F304H           |     | A351 Gr. CF8 [Note (1)] |     | A240 Gr. 304H           |       |
| Working Pressure by Classes, psig |                          |     |                         |     |                         |       |
| Temperature, °F                   | 75                       | 150 | 300                     | 400 | 600                     | 900   |
| –20 to 100                        | 140                      | 275 | 720                     | 960 | 1,440                   | 2,160 |
| 200                               | 115                      | 230 | 600                     | 800 | 1,200                   | 1,800 |
| 300                               | 105                      | 205 | 540                     | 715 | 1,075                   | 1,615 |
| 400                               | 95                       | 190 | 495                     | 660 | 995                     | 1,490 |
| 500                               | 85                       | 170 | 465                     | 620 | 930                     | 1,395 |
| 600                               | 70                       | 140 | 440                     | 590 | 885                     | 1,325 |
| 650                               | 60                       | 125 | 430                     | 575 | 865                     | 1,295 |
| 700                               | ...                      | 110 | 420                     | 565 | 845                     | 1,265 |
| 750                               | ...                      | 95  | 415                     | 550 | 825                     | 1,240 |
| 800                               | ...                      | 80  | 405                     | 540 | 810                     | 1,215 |
| 850                               | ...                      | 65  | 395                     | 530 | 790                     | 1,190 |
| 900                               | ...                      | 50  | 390                     | 520 | 780                     | 1,165 |
| 950                               | ...                      | 35  | 380                     | 510 | 765                     | 1,145 |
| 1,000                             | ...                      | 20  | 355                     | 470 | 710                     | 1,065 |
| 1,050                             | ...                      | ... | 325                     | 435 | 650                     | 975   |
| 1,100                             | ...                      | ... | 255                     | 345 | 515                     | 770   |
| 1,150                             | ...                      | ... | 205                     | 275 | 410                     | 615   |
| 1,200                             | ...                      | ... | 165                     | 220 | 330                     | 495   |
| 1,250                             | ...                      | ... | 135                     | 180 | 265                     | 400   |
| 1,300                             | ...                      | ... | 115                     | 150 | 225                     | 340   |
| 1,350                             | ...                      | ... | 95                      | 125 | 185                     | 280   |
| 1,400                             | ...                      | ... | 75                      | 100 | 150                     | 225   |
| 1,450                             | ...                      | ... | 60                      | 80  | 115                     | 175   |
| 1,500                             | ...                      | ... | 40                      | 55  | 85                      | 125   |

## NOTES:

(1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

(2) Not to be used over 800°F.

**Table I-16 Pressure–Temperature Ratings for Group 2.2 Materials**

| Nominal Designation | Forgings                 | Castings                 | Plates                  |
|---------------------|--------------------------|--------------------------|-------------------------|
| 16Cr–12Ni–2Mo       | A182 Gr. F316 [Note (1)] | A351 Gr. CF3M [Note (2)] | A240 Gr. 316 [Note (1)] |
| 16Cr–12Ni–2Mo       | A182 Gr. F316H           | A351 Gr. CF8M [Note (1)] | A240 Gr. 316H           |
| 18Cr–13Ni–3Mo       | A182 Gr. F317 [Note (1)] | ...                      | A240 Gr. 317 [Note (1)] |
| 19Cr–10Ni–3Mo       | ...                      | A351 Gr. CG8M [Note (3)] | ...                     |

| Temperature, °F | Working Pressure by Classes, psig |     |     |     |       |       |
|-----------------|-----------------------------------|-----|-----|-----|-------|-------|
|                 | 75                                | 150 | 300 | 400 | 600   | 900   |
| -20 to 100      | 140                               | 275 | 720 | 960 | 1,440 | 2,160 |
| 200             | 120                               | 235 | 620 | 825 | 1,240 | 1,860 |
| 300             | 105                               | 215 | 560 | 745 | 1,120 | 1,680 |
| 400             | 100                               | 195 | 515 | 685 | 1,025 | 1,540 |
| 500             | 85                                | 170 | 480 | 635 | 955   | 1,435 |
| 600             | 70                                | 140 | 450 | 600 | 900   | 1,355 |
| 650             | 60                                | 125 | 440 | 590 | 885   | 1,325 |
| 700             | ...                               | 110 | 435 | 580 | 870   | 1,305 |
| 750             | ...                               | 95  | 425 | 570 | 855   | 1,280 |
| 800             | ...                               | 80  | 420 | 565 | 845   | 1,265 |
| 850             | ...                               | 65  | 420 | 555 | 835   | 1,255 |
| 900             | ...                               | 50  | 415 | 555 | 830   | 1,245 |
| 950             | ...                               | 35  | 385 | 515 | 775   | 1,160 |
| 1,000           | ...                               | 20  | 365 | 485 | 725   | 1,090 |
| 1,050           | ...                               | ... | 360 | 480 | 720   | 1,080 |
| 1,100           | ...                               | ... | 305 | 405 | 610   | 915   |
| 1,150           | ...                               | ... | 235 | 315 | 475   | 710   |
| 1,200           | ...                               | ... | 185 | 245 | 370   | 555   |
| 1,250           | ...                               | ... | 145 | 195 | 295   | 440   |
| 1,300           | ...                               | ... | 115 | 155 | 235   | 350   |
| 1,350           | ...                               | ... | 95  | 130 | 190   | 290   |
| 1,400           | ...                               | ... | 75  | 100 | 150   | 225   |
| 1,450           | ...                               | ... | 60  | 80  | 115   | 175   |
| 1,500           | ...                               | ... | 40  | 55  | 85    | 125   |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) Not to be used over 850°F.
- (3) Not to be used over 1,000°F.

**Table I-17 Pressure-Temperature Ratings for Group 2.3 Materials**

| <b>Nominal Designation</b>               | <b>Forgings</b>           | <b>Castings</b> | <b>Plates</b>            |            |            |            |
|--|---------------------------|-----------------|--------------------------|------------|------------|------------|
| 18Cr-8Ni                                 | A182 Gr. F304L [Note (1)] | ...             | A240 Gr. 304L [Note (1)] |            |            |            |
| 16Cr-12Ni-2Mo                            | A182 Gr. F316L            | ...             | A240 Gr. 316L            |            |            |            |
| 18Cr-13Ni-3Mo                            | A182 Gr. 317L             | ...             | ...                      |            |            |            |
| <b>Working Pressure by Classes, psig</b> |                           |                 |                          |            |            |            |
| <b>Temperature, °F</b>                   | <b>75</b>                 | <b>150</b>      | <b>300</b>               | <b>400</b> | <b>600</b> | <b>900</b> |
| -20 to 100                               | 115                       | 230             | 600                      | 800        | 1,200      | 1,800      |
| 200                                      | 100                       | 195             | 510                      | 680        | 1,020      | 1,535      |
| 300                                      | 85                        | 175             | 455                      | 610        | 910        | 1,370      |
| 400                                      | 80                        | 160             | 420                      | 560        | 840        | 1,260      |
| 500                                      | 75                        | 150             | 395                      | 525        | 785        | 1,180      |
| 600                                      | 70                        | 140             | 370                      | 495        | 745        | 1,115      |
| 650                                      | 60                        | 125             | 365                      | 485        | 730        | 1,095      |
| 700                                      | ...                       | 110             | 360                      | 480        | 720        | 1,080      |
| 750                                      | ...                       | 95              | 355                      | 470        | 705        | 1,060      |
| 800                                      | ...                       | 80              | 345                      | 460        | 690        | 1,035      |
| 850                                      | ...                       | 65              | 340                      | 450        | 675        | 1,015      |

NOTE: (1) Not to be used over 800°F.

**Table I-18 Pressure–Temperature Ratings for Group 2.4 Materials**

| Nominal Designation               | Forgings                  |     | Castings |     | Plates                   |       |
|-----------------------------------|---------------------------|-----|----------|-----|--------------------------|-------|
|                                   |                           |     |          |     |                          |       |
| 18Cr–10Ni–Ti                      | A182 Gr. F321 [Note (1)]  |     | ...      |     | A240 Gr. 321 [Note (1)]  |       |
| 18Cr–10Ni–Ti                      | A182 Gr. F321H [Note (2)] |     | ...      |     | A240 Gr. 321H [Note (2)] |       |
| Working Pressure by Classes, psig |                           |     |          |     |                          |       |
| Temperature, °F                   | 75                        | 150 | 300      | 400 | 600                      | 900   |
| -20 to 100                        | 140                       | 275 | 720      | 960 | 1,440                    | 2,160 |
| 200                               | 125                       | 250 | 650      | 865 | 1,295                    | 1,945 |
| 300                               | 115                       | 230 | 595      | 795 | 1,190                    | 1,785 |
| 400                               | 100                       | 200 | 550      | 735 | 1,105                    | 1,655 |
| 500                               | 85                        | 170 | 515      | 690 | 1,030                    | 1,550 |
| 600                               | 70                        | 140 | 485      | 650 | 975                      | 1,460 |
| 650                               | 60                        | 125 | 475      | 635 | 950                      | 1,425 |
| 700                               | ...                       | 110 | 465      | 620 | 930                      | 1,395 |
| 750                               | ...                       | 95  | 460      | 610 | 915                      | 1,375 |
| 800                               | ...                       | 80  | 450      | 600 | 900                      | 1,355 |
| 850                               | ...                       | 65  | 445      | 595 | 895                      | 1,340 |
| 900                               | ...                       | 50  | 440      | 590 | 885                      | 1,325 |
| 950                               | ...                       | 35  | 385      | 515 | 775                      | 1,160 |
| 1,000                             | ...                       | 20  | 365      | 485 | 725                      | 1,090 |
| 1,050                             | ...                       | ... | 360      | 480 | 720                      | 1,080 |
| 1,100                             | ...                       | ... | 310      | 415 | 625                      | 935   |
| 1,150                             | ...                       | ... | 235      | 315 | 475                      | 710   |
| 1,200                             | ...                       | ... | 185      | 245 | 370                      | 555   |
| 1,250                             | ...                       | ... | 140      | 185 | 280                      | 420   |
| 1,300                             | ...                       | ... | 110      | 145 | 220                      | 330   |
| 1,350                             | ...                       | ... | 85       | 115 | 170                      | 255   |
| 1,400                             | ...                       | ... | 65       | 85  | 130                      | 195   |
| 1,450                             | ...                       | ... | 50       | 70  | 105                      | 155   |
| 1,500                             | ...                       | ... | 40       | 50  | 75                       | 115   |

NOTES:

(1) Not to be used over 1,000°F.

(2) At temperatures over 1,000°F, use only if the material is heat treated by heating to a minimum temperature of 2,000°F.

Table I-19 Pressure–Temperature Ratings for Group 2.5 Materials

| Nominal Designation               | Forgings                  |     | Castings |     | Plates                   |       |
|-----------------------------------|---------------------------|-----|----------|-----|--------------------------|-------|
|                                   |                           |     |          |     |                          |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F347 [Note (1)]  |     | ...      |     | A240 Gr. 347 [Note (1)]  |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F347H [Note (2)] |     | ...      |     | A240 Gr. 347H [Note (2)] |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F348 [Note (1)]  |     | ...      |     | A240 Gr. 348 [Note (1)]  |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F348H [Note (2)] |     | ...      |     | A240 Gr. 348H [Note (2)] |       |
| Working Pressure by Classes, psig |                           |     |          |     |                          |       |
| Temperature, °F                   | 75                        | 150 | 300      | 400 | 600                      | 900   |
| –20 to 100                        | 140                       | 275 | 720      | 960 | 1,440                    | 2,160 |
| 200                               | 125                       | 255 | 660      | 885 | 1,325                    | 1,985 |
| 300                               | 115                       | 230 | 615      | 820 | 1,235                    | 1,850 |
| 400                               | 100                       | 200 | 575      | 770 | 1,150                    | 1,730 |
| 500                               | 85                        | 170 | 540      | 725 | 1,085                    | 1,625 |
| 600                               | 70                        | 140 | 515      | 690 | 1,030                    | 1,550 |
| 650                               | 60                        | 125 | 505      | 675 | 1,015                    | 1,520 |
| 700                               | ...                       | 110 | 495      | 660 | 995                      | 1,490 |
| 750                               | ...                       | 95  | 490      | 655 | 985                      | 1,475 |
| 800                               | ...                       | 80  | 485      | 650 | 975                      | 1,460 |
| 850                               | ...                       | 65  | 485      | 645 | 970                      | 1,455 |
| 900                               | ...                       | 50  | 450      | 600 | 900                      | 1,350 |
| 950                               | ...                       | 35  | 385      | 515 | 775                      | 1,160 |
| 1,000                             | ...                       | 20  | 365      | 485 | 725                      | 1,090 |
| 1,050                             | ...                       | ... | 360      | 480 | 720                      | 1,080 |
| 1,100                             | ...                       | ... | 325      | 430 | 645                      | 965   |
| 1,150                             | ...                       | ... | 275      | 365 | 550                      | 825   |
| 1,200                             | ...                       | ... | 205      | 275 | 410                      | 620   |
| 1,250                             | ...                       | ... | 180      | 245 | 365                      | 545   |
| 1,300                             | ...                       | ... | 140      | 185 | 275                      | 410   |
| 1,350                             | ...                       | ... | 105      | 140 | 205                      | 310   |
| 1,400                             | ...                       | ... | 75       | 100 | 150                      | 225   |
| 1,450                             | ...                       | ... | 60       | 80  | 115                      | 175   |
| 1,500                             | ...                       | ... | 40       | 55  | 85                       | 125   |

## NOTES:

(1) Not to be used over 1,000°F.

(2) For temperatures over 1,000°F, use only if the material is heat treated by heating to a minimum temperature of 2,000°F.



**Table I-20 Pressure–Temperature Ratings for Group 2.6 Materials**

| Nominal Designation | Forgings                          |     | Castings |     | Plates        |       |
|---------------------|-----------------------------------|-----|----------|-----|---------------|-------|
|                     | Working Pressure by Classes, psig |     |          |     |               |       |
| Temperature, °F     | 75                                | 150 | 300      | 400 | 600           | 900   |
| 23Cr–12Ni           | ...                               | ... | ...      | ... | A240 Gr. 309H |       |
| –20 to 100          | 140                               | 275 | 720      | 960 | 1,440         | 2,160 |
| 200                 | 120                               | 240 | 630      | 840 | 1,260         | 1,895 |
| 300                 | 110                               | 225 | 580      | 775 | 1,160         | 1,740 |
| 400                 | 100                               | 200 | 545      | 725 | 1,090         | 1,635 |
| 500                 | 85                                | 170 | 520      | 690 | 1,035         | 1,555 |
| 600                 | 70                                | 140 | 500      | 665 | 1,000         | 1,500 |
| 650                 | 60                                | 125 | 490      | 655 | 985           | 1,475 |
| 700                 | ...                               | 110 | 485      | 645 | 970           | 1,455 |
| 750                 | ...                               | 95  | 480      | 640 | 960           | 1,440 |
| 800                 | ...                               | 80  | 475      | 630 | 945           | 1,420 |
| 850                 | ...                               | 65  | 465      | 620 | 930           | 1,395 |
| 900                 | ...                               | 50  | 450      | 600 | 900           | 1,350 |
| 950                 | ...                               | 35  | 385      | 515 | 775           | 1,160 |
| 1,000               | ...                               | 20  | 365      | 485 | 725           | 1,090 |
| 1,050               | ...                               | ... | 355      | 470 | 705           | 1,060 |
| 1,100               | ...                               | ... | 260      | 345 | 520           | 780   |
| 1,150               | ...                               | ... | 190      | 250 | 375           | 565   |
| 1,200               | ...                               | ... | 135      | 185 | 275           | 410   |
| 1,250               | ...                               | ... | 105      | 135 | 205           | 310   |
| 1,300               | ...                               | ... | 75       | 100 | 150           | 225   |
| 1,350               | ...                               | ... | 60       | 80  | 115           | 175   |
| 1,400               | ...                               | ... | 45       | 60  | 90            | 135   |
| 1,450               | ...                               | ... | 35       | 45  | 70            | 105   |
| 1,500               | ...                               | ... | 25       | 35  | 50            | 75    |

Table I-21 Pressure–Temperature Ratings for Group 2.7 Materials

| Nominal Designation | Forgings                          |     | Castings |     | Plates        |       |
|---------------------|-----------------------------------|-----|----------|-----|---------------|-------|
|                     | A182 Gr. F310 [Notes (1), (2)]    |     | ...      |     | A240 Gr. 310H |       |
| Temperature, °F     | Working Pressure by Classes, psig |     |          |     |               |       |
|                     | 75                                | 150 | 300      | 400 | 600           | 900   |
| -20 to 100          | 140                               | 275 | 720      | 960 | 1,440         | 2,160 |
| 200                 | 120                               | 245 | 635      | 850 | 1,270         | 1,910 |
| 300                 | 110                               | 225 | 580      | 775 | 1,160         | 1,740 |
| 400                 | 100                               | 200 | 540      | 725 | 1,085         | 1,625 |
| 500                 | 85                                | 170 | 515      | 685 | 1,025         | 1,540 |
| 600                 | 70                                | 140 | 495      | 660 | 990           | 1,485 |
| 650                 | 60                                | 125 | 485      | 645 | 970           | 1,455 |
| 700                 | ...                               | 110 | 480      | 635 | 955           | 1,435 |
| 750                 | ...                               | 95  | 470      | 625 | 940           | 1,410 |
| 800                 | ...                               | 80  | 465      | 620 | 930           | 1,395 |
| 850                 | ...                               | 65  | 460      | 610 | 915           | 1,375 |
| 900                 | ...                               | 50  | 450      | 600 | 900           | 1,350 |
| 950                 | ...                               | 35  | 385      | 515 | 775           | 1,160 |
| 1,000               | ...                               | 20  | 365      | 485 | 725           | 1,090 |
| 1,050               | ...                               | ... | 355      | 470 | 705           | 1,060 |
| 1,100               | ...                               | ... | 260      | 345 | 520           | 780   |
| 1,150               | ...                               | ... | 190      | 250 | 375           | 565   |
| 1,200               | ...                               | ... | 135      | 185 | 275           | 410   |
| 1,250               | ...                               | ... | 105      | 135 | 205           | 310   |
| 1,300               | ...                               | ... | 75       | 100 | 150           | 225   |
| 1,350               | ...                               | ... | 60       | 80  | 115           | 175   |
| 1,400               | ...                               | ... | 45       | 60  | 90            | 135   |
| 1,450               | ...                               | ... | 35       | 45  | 65            | 100   |
| 1,500               | ...                               | ... | 25       | 35  | 50            | 75    |

## NOTES:

(1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

(2) Service temperatures of 1,050°F and above should be used only when assurance is provided that grain size is not finer than ASTM 6.

**Table I-22 Pressure–Temperature Ratings for Group 2.8 Materials**

| Nominal Designation                      | Forgings                |     | Castings                     |       | Plates                     |       |
|--|-------------------------|-----|------------------------------|-------|----------------------------|-------|
|  |                         |     |                              |       |                            |       |
| 20Cr–18Ni–6Mo                            | A182 Gr. F44            |     | A351 Gr. CK3MCuN             |       | A240 Gr. S31254            |       |
| 22Cr–5Ni–3Mo–N                           | A182 Gr. F51 [Note (1)] |     | ...                          |       | A240 Gr. S31803 [Note (1)] |       |
| 25Cr–7Ni–4Mo–N                           | A182 Gr. F53 [Note (1)] |     | ...                          |       | A240 Gr. S32750 [Note (1)] |       |
| 24Cr–10Ni–4Mo–V                          | ...                     |     | A351 Gr. CE8MN [Note (1)]    |       | ...                        |       |
| 25Cr–5Ni–2Mo–3Cu                         | ...                     |     | A995 Gr. CD4MCu [Note (1)]   |       | ...                        |       |
| 25Cr–7Ni–3.5Mo–W–Cb                      | ...                     |     | A995 Gr. CD3MWCuN [Note (1)] |       | ...                        |       |
| 25Cr–7Ni–3.5Mo–N–Cu–W                    | A182 Gr. F55 [Note (1)] |     | ...                          |       | A240 Gr. S32760 [Note (1)] |       |
| <b>Working Pressure by Classes, psig</b> |                         |     |                              |       |                            |       |
| Temperature, °F                          | 75                      | 150 | 300                          | 400   | 600                        | 900   |
| –20 to 100                               | 145                     | 290 | 750                          | 1,000 | 1,500                      | 2,250 |
| 200                                      | 130                     | 260 | 745                          | 990   | 1,490                      | 2,230 |
| 300                                      | 115                     | 230 | 665                          | 890   | 1,335                      | 2,000 |
| 400                                      | 100                     | 200 | 615                          | 820   | 1,230                      | 1,845 |
| 500                                      | 85                      | 170 | 580                          | 775   | 1,160                      | 1,740 |
| 600                                      | 70                      | 140 | 555                          | 740   | 1,115                      | 1,670 |
| 650                                      | 60                      | 125 | 545                          | 730   | 1,095                      | 1,640 |
| 700                                      | ...                     | 110 | 540                          | 725   | 1,085                      | 1,625 |
| 750                                      | ...                     | 95  | 530                          | 710   | 1,065                      | 1,595 |

NOTE: (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 600°F.

**Table I-23 Pressure–Temperature Ratings for Group 2.9 Materials**

| Nominal Designation               | Forgings |     | Castings |     | Plates                        |       |
|-----------------------------------|----------|-----|----------|-----|-------------------------------|-------|
|                                   |          |     |          |     |                               |       |
| 23Cr–12Ni                         | ...      |     | ...      |     | A240 Gr. 309S [Notes (1)–(3)] |       |
| 25Cr–20Ni                         | ...      |     | ...      |     | A240 Gr. 310S [Notes (1)–(3)] |       |
| Working Pressure by Classes, psig |          |     |          |     |                               |       |
| Temperature, °F                   | 75       | 150 | 300      | 400 | 600                           | 900   |
| -20 to 100                        | 140      | 275 | 720      | 960 | 1,440                         | 2,160 |
| 200                               | 120      | 240 | 630      | 840 | 1,260                         | 1,895 |
| 300                               | 110      | 225 | 580      | 775 | 1,160                         | 1,740 |
| 400                               | 100      | 200 | 540      | 725 | 1,085                         | 1,625 |
| 500                               | 85       | 170 | 515      | 685 | 1,025                         | 1,540 |
| 600                               | 70       | 140 | 495      | 660 | 990                           | 1,485 |
| 650                               | 60       | 125 | 485      | 645 | 970                           | 1,455 |
| 700                               | ...      | 110 | 480      | 635 | 955                           | 1,435 |
| 750                               | ...      | 95  | 470      | 625 | 940                           | 1,410 |
| 800                               | ...      | 80  | 465      | 620 | 930                           | 1,395 |
| 850                               | ...      | 65  | 460      | 610 | 915                           | 1,375 |
| 900                               | ...      | 50  | 450      | 600 | 900                           | 1,350 |
| 950                               | ...      | 35  | 385      | 515 | 775                           | 1,160 |
| 1,000                             | ...      | 20  | 340      | 455 | 680                           | 1,020 |
| 1,050                             | ...      | ... | 245      | 325 | 485                           | 730   |
| 1,100                             | ...      | ... | 170      | 230 | 345                           | 515   |
| 1,150                             | ...      | ... | 125      | 165 | 245                           | 370   |
| 1,200                             | ...      | ... | 85       | 115 | 170                           | 255   |
| 1,250                             | ...      | ... | 50       | 70  | 105                           | 155   |
| 1,300                             | ...      | ... | 25       | 35  | 55                            | 80    |
| 1,350                             | ...      | ... | 15       | 25  | 35                            | 50    |
| 1,400                             | ...      | ... | 15       | 20  | 25                            | 40    |
| 1,450                             | ...      | ... | 10       | 15  | 20                            | 30    |
| 1,500                             | ...      | ... | 5        | 10  | 15                            | 20    |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 1,000°F, use only if the material is solution heat treated to the minimum temperature specified in the specification, but not lower than 1,900°F, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 1,050°F and above only when assurance is provided that grain size is not finer than ASTM 6.

**Table I-24 Pressure-Temperature Ratings for Group 2.10 Materials**

| Nominal Designation               | Forgings |     | Castings |                          |       | Plates |
|-----------------------------------|----------|-----|----------|--------------------------|-------|--------|
|                                   |          |     |          |                          |       |        |
| 25Cr-12Ni                         | ...      |     |          | A351 Gr. CH8 [Note (1)]  |       | ...    |
| 25Cr-12Ni                         | ...      |     |          | A351 Gr. CH20 [Note (1)] |       | ...    |
| Working Pressure by Classes, psig |          |     |          |                          |       |        |
| Temperature, °F                   | 75       | 150 | 300      | 400                      | 600   | 900    |
| -20 to 100                        | 130      | 260 | 670      | 895                      | 1,345 | 2,015  |
| 200                               | 105      | 210 | 550      | 735                      | 1,100 | 1,650  |
| 300                               | 95       | 195 | 505      | 675                      | 1,015 | 1,520  |
| 400                               | 95       | 185 | 485      | 645                      | 970   | 1,455  |
| 500                               | 85       | 170 | 470      | 625                      | 940   | 1,410  |
| 600                               | 70       | 140 | 455      | 610                      | 910   | 1,370  |
| 650                               | 60       | 125 | 445      | 595                      | 895   | 1,340  |
| 700                               | ...      | 110 | 435      | 580                      | 870   | 1,305  |
| 750                               | ...      | 95  | 420      | 565                      | 845   | 1,265  |
| 800                               | ...      | 80  | 410      | 545                      | 820   | 1,230  |
| 850                               | ...      | 65  | 400      | 530                      | 795   | 1,195  |
| 900                               | ...      | 50  | 385      | 510                      | 770   | 1,150  |
| 950                               | ...      | 35  | 370      | 495                      | 740   | 1,110  |
| 1,000                             | ...      | 20  | 340      | 450                      | 675   | 1,015  |
| 1,050                             | ...      | ... | 290      | 390                      | 585   | 875    |
| 1,100                             | ...      | ... | 225      | 295                      | 445   | 670    |
| 1,150                             | ...      | ... | 170      | 230                      | 345   | 515    |
| 1,200                             | ...      | ... | 130      | 175                      | 260   | 390    |
| 1,250                             | ...      | ... | 100      | 135                      | 200   | 300    |
| 1,300                             | ...      | ... | 80       | 105                      | 160   | 235    |
| 1,350                             | ...      | ... | 60       | 80                       | 125   | 165    |
| 1,400                             | ...      | ... | 45       | 60                       | 90    | 135    |
| 1,450                             | ...      | ... | 30       | 40                       | 60    | 95     |
| 1,500                             | ...      | ... | 25       | 35                       | 55    | 80     |

NOTE: (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

**Table I-25 Pressure–Temperature Ratings for Group 2.11 Materials**

| Nominal Designation | Forgings                          |     | Castings |     |                          | Plates |
|---------------------|-----------------------------------|-----|----------|-----|--------------------------|--------|
|                     | Working Pressure by Classes, psig |     |          |     |                          |        |
| Temperature, °F     | 75                                | 150 | 300      | 400 | 600                      | 900    |
| 18Cr–10Ni–Cb        | ...                               |     |          |     |                          | ...    |
|                     |                                   |     |          |     | A351 Gr. CF8C [Note (1)] |        |
| -20 to 100          | 140                               | 275 | 720      | 960 | 1,440                    | 2,160  |
| 200                 | 125                               | 255 | 660      | 885 | 1,325                    | 1,985  |
| 300                 | 115                               | 230 | 615      | 820 | 1,235                    | 1,850  |
| 400                 | 100                               | 200 | 575      | 770 | 1,150                    | 1,730  |
| 500                 | 85                                | 170 | 540      | 725 | 1,085                    | 1,625  |
| 600                 | 70                                | 140 | 515      | 690 | 1,030                    | 1,550  |
| 650                 | 60                                | 125 | 505      | 675 | 1,015                    | 1,520  |
| 700                 | ...                               | 110 | 495      | 660 | 995                      | 1,490  |
| 750                 | ...                               | 95  | 490      | 655 | 985                      | 1,475  |
| 800                 | ...                               | 80  | 485      | 650 | 975                      | 1,460  |
| 850                 | ...                               | 65  | 485      | 645 | 970                      | 1,455  |
| 900                 | ...                               | 50  | 450      | 600 | 900                      | 1,350  |
| 950                 | ...                               | 35  | 385      | 515 | 775                      | 1,160  |
| 1,000               | ...                               | 20  | 365      | 485 | 725                      | 1,090  |
| 1,050               | ...                               | ... | 360      | 480 | 720                      | 1,080  |
| 1,100               | ...                               | ... | 310      | 415 | 625                      | 935    |
| 1,150               | ...                               | ... | 210      | 280 | 420                      | 625    |
| 1,200               | ...                               | ... | 150      | 200 | 300                      | 455    |
| 1,250               | ...                               | ... | 115      | 150 | 225                      | 340    |
| 1,300               | ...                               | ... | 75       | 100 | 150                      | 225    |
| 1,350               | ...                               | ... | 50       | 70  | 105                      | 155    |
| 1,400               | ...                               | ... | 40       | 55  | 80                       | 125    |
| 1,450               | ...                               | ... | 30       | 40  | 60                       | 95     |
| 1,500               | ...                               | ... | 25       | 35  | 55                       | 80     |

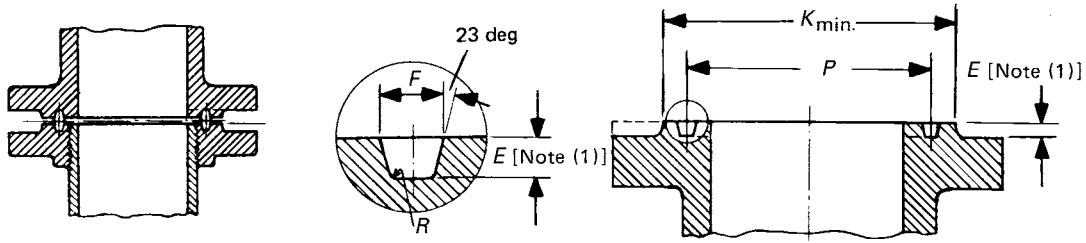
NOTE: (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

**Table I-26 Pressure-Temperature Ratings for Group 2.12 Materials**

| Nominal Designation | Forgings                          |                          | Castings |     |       | Plates |
|---------------------|-----------------------------------|--------------------------|----------|-----|-------|--------|
|                     | Working Pressure by Classes, psig |                          |          |     |       |        |
| Temperature, °F     | 75                                | 150                      | 300      | 400 | 600   | 900    |
| 25Cr-20Ni           | ...                               | A351 Gr. CK20 [Note (1)] |          |     | ...   | ...    |
| -20 to 100          | 130                               | 260                      | 670      | 895 | 1,345 | 2,015  |
| 200                 | 105                               | 210                      | 550      | 735 | 1,100 | 1,650  |
| 300                 | 95                                | 195                      | 505      | 675 | 1,015 | 1,520  |
| 400                 | 95                                | 185                      | 485      | 645 | 970   | 1,455  |
| 500                 | 85                                | 170                      | 470      | 625 | 940   | 1,410  |
| 600                 | 70                                | 140                      | 455      | 610 | 910   | 1,370  |
| 650                 | 60                                | 125                      | 445      | 595 | 895   | 1,340  |
| 700                 | ...                               | 110                      | 435      | 580 | 870   | 1,305  |
| 750                 | ...                               | 95                       | 420      | 565 | 845   | 1,265  |
| 800                 | ...                               | 80                       | 410      | 545 | 820   | 1,230  |
| 850                 | ...                               | 65                       | 400      | 530 | 795   | 1,195  |
| 900                 | ...                               | 50                       | 385      | 510 | 770   | 1,150  |
| 950                 | ...                               | 35                       | 370      | 495 | 740   | 1,110  |
| 1,000               | ...                               | 20                       | 340      | 450 | 675   | 1,015  |
| 1,050               | ...                               | ...                      | 325      | 435 | 650   | 975    |
| 1,100               | ...                               | ...                      | 290      | 390 | 585   | 875    |
| 1,150               | ...                               | ...                      | 250      | 335 | 500   | 750    |
| 1,200               | ...                               | ...                      | 205      | 275 | 410   | 615    |
| 1,250               | ...                               | ...                      | 165      | 220 | 330   | 495    |
| 1,300               | ...                               | ...                      | 120      | 160 | 240   | 360    |
| 1,350               | ...                               | ...                      | 60       | 110 | 165   | 245    |
| 1,400               | ...                               | ...                      | 55       | 75  | 110   | 165    |
| 1,450               | ...                               | ...                      | 40       | 50  | 75    | 115    |
| 1,500               | ...                               | ...                      | 25       | 35  | 55    | 80     |

NOTE: (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

**Table I-27 Dimensions of Ring-Joint Facings**



| Nominal Pipe Size for Class |     |     |     | Groove Dimensions |                          |                 |                 |                            | Diameter of Raised Portion, <i>K</i> |
|-----------------------------|-----|-----|-----|-------------------|--------------------------|-----------------|-----------------|----------------------------|--------------------------------------|
| 300                         | 400 | 600 | 900 | Groove Number     | Pitch Diameter, <i>P</i> | Depth, <i>E</i> | Width, <i>F</i> | Radius at Bottom, <i>R</i> |                                      |
| 26                          | 26  | 26  | ... | R93               | 29.500                   | 0.500           | 0.781           | 0.06                       | 31.88                                |
| 28                          | 28  | 28  | ... | R94               | 31.500                   | 0.500           | 0.781           | 0.06                       | 33.88                                |
| 30                          | 30  | 30  | ... | R95               | 33.750                   | 0.500           | 0.781           | 0.06                       | 36.12                                |
| 32                          | 32  | 32  | ... | R96               | 36.000                   | 0.562           | 0.906           | 0.06                       | 38.75                                |
| 34                          | 34  | 34  | ... | R97               | 38.000                   | 0.562           | 0.906           | 0.06                       | 40.75                                |
| 36                          | 36  | 36  | ... | R98               | 40.250                   | 0.562           | 0.906           | 0.06                       | 43.00                                |
| ...                         | ... | ... | 26  | R100              | 29.500                   | 0.688           | 1.188           | 0.09                       | 32.75                                |
| ...                         | ... | ... | 28  | R101              | 31.500                   | 0.688           | 1.312           | 0.09                       | 35.00                                |
| ...                         | ... | ... | 30  | R102              | 33.750                   | 0.688           | 1.312           | 0.09                       | 37.25                                |
| ...                         | ... | ... | 32  | R103              | 36.000                   | 0.688           | 1.312           | 0.09                       | 39.50                                |
| ...                         | ... | ... | 34  | R104              | 38.000                   | 0.812           | 1.438           | 0.09                       | 42.00                                |
| ...                         | ... | ... | 36  | R105              | 40.250                   | 0.812           | 1.438           | 0.09                       | 44.25                                |

**Tolerances**

|                             |  |
|-----------------------------|--|
| <i>E</i> (depth)            | +0.016, -0.0   |
| <i>F</i> (width)            | ±0.008   |
| <i>P</i> (pitch diameter)   | ±0.005   |
| <i>R</i> (radius at bottom) | +0.03, -0.0 for <i>R</i> ≤ 0.06<br>±0.03 for <i>R</i> > 0.06 |
| 23 deg angle                | ±½ deg   |

**GENERAL NOTES:**

- (a) Dimensions are in inches.
- (b) Ring-joint gaskets are not contemplated for NPS 38 and larger flanges.
- (c) For facing requirements for flanges, see [para 6.1](#).
- (d) See [para. 4.2](#) for marking requirements.

NOTE: (1) Height of raised portion is equal to the depth of groove dimension *E*, but is not subjected to the tolerances for *E*. Full face contour may be used.

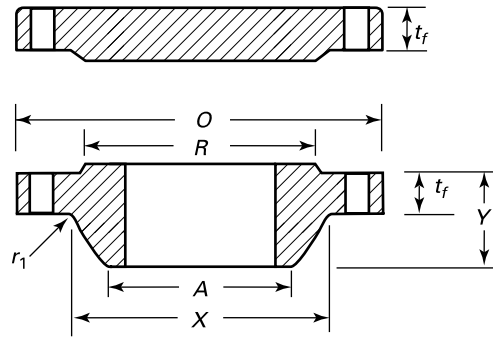


**Table I-28 Permissible Imperfections in Flange Facing Finish**

| <b>Nominal Pipe Size</b> | <b>Maximum Radial Projection of Imperfections That Are No Deeper Than Bottom of Serration, in.</b> | <b>Maximum Depth and Radial Projection of Imperfections That Are Deeper Than Bottom of Serration, in.</b> |
|--------------------------|--|---|
| 26-36                    | 0.50   | 0.25  |
| 38-48                    | 0.56   | 0.28  |
| 50-60                    | 0.62   | 0.31  |

GENERAL NOTE: See [para. 6.1.5](#).

**Table I-29 Dimensions of Class 150 Series A Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |                               |      |
| 26                | 34.25               | 2.63  | 2.63  | 4.69                    | 26.62                        | 26.00                         | 29.50                  | 31.75                | 24                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 0.38 |
| 28                | 36.50               | 2.75  | 2.75  | 4.88                    | 28.62                        | 28.00                         | 31.50                  | 34.00                | 28                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 0.44 |
| 30                | 38.75               | 2.88  | 2.88  | 5.32                    | 30.75                        | 30.00                         | 33.75                  | 36.00                | 28                | 1 <sup>3</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>4</sub> | 0.44 |
| 32                | 41.75               | 3.13  | 3.13  | 5.63                    | 32.75                        | 32.00                         | 36.00                  | 38.50                | 28                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.44 |
| 34                | 43.75               | 3.19  | 3.19  | 5.82                    | 34.75                        | 34.00                         | 38.00                  | 40.50                | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 36                | 46.00               | 3.50  | 3.50  | 6.13                    | 36.75                        | 36.00                         | 40.25                  | 42.75                | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 38                | 48.75               | 3.38  | 3.38  | 6.13                    | 39.00                        | 38.00                         | 42.25                  | 45.25                | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 40                | 50.75               | 3.50  | 3.50  | 6.38                    | 41.00                        | 40.00                         | 44.25                  | 47.25                | 36                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 42                | 53.00               | 3.75  | 3.75  | 6.69                    | 43.00                        | 42.00                         | 47.00                  | 49.50                | 36                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 44                | 55.25               | 3.94  | 3.94  | 6.94                    | 45.00                        | 44.00                         | 49.00                  | 51.75                | 40                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 46                | 57.25               | 4.00  | 4.00  | 7.25                    | 47.12                        | 46.00                         | 51.00                  | 53.75                | 40                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 48                | 59.50               | 4.19  | 4.19  | 7.50                    | 49.12                        | 48.00                         | 53.50                  | 56.00                | 44                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub> | 0.50 |
| 50                | 61.75               | 4.32  | 4.32  | 7.94                    | 51.25                        | 50.00                         | 55.50                  | 58.25                | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 52                | 64.00               | 4.50  | 4.50  | 8.19                    | 53.25                        | 52.00                         | 57.50                  | 60.50                | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 54                | 66.25               | 4.69  | 4.69  | 8.44                    | 55.25                        | 54.00                         | 59.50                  | 62.75                | 44                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 56                | 68.75               | 4.82  | 4.82  | 8.94                    | 57.38                        | 56.00                         | 62.00                  | 65.00                | 48                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 58                | 71.00               | 5.00  | 5.00  | 9.19                    | 59.38                        | 58.00                         | 64.00                  | 67.25                | 48                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 60                | 73.00               | 5.13  | 5.13  | 9.38                    | 61.38                        | 60.00                         | 66.00                  | 69.25                | 52                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |

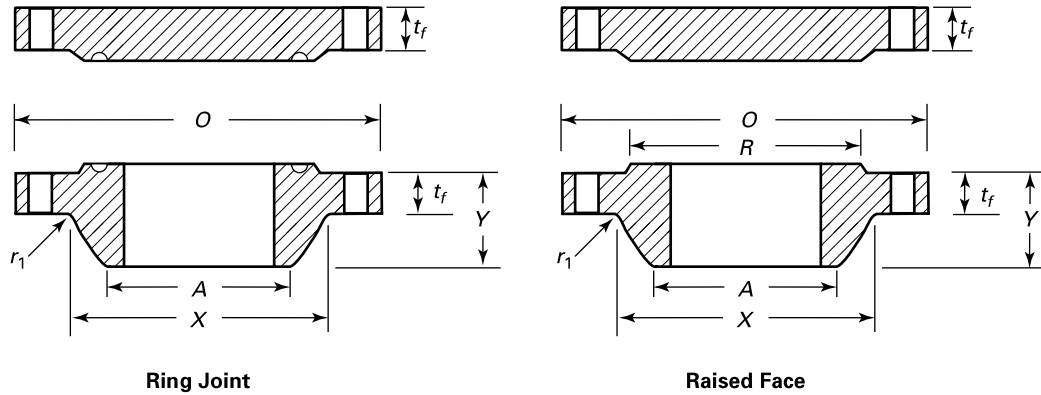
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's options.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table I-30 Dimensions of Class 300 Series A Flanges**



| Nominal Pipe Size | O.D. of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> [Note (1)] |       | Length Through Hub, <i>Y</i> | Diam. of Hub, <i>X</i> [Note (2)] | Hub Diam. Top, <i>A</i> [Note (3)] | Raised Face Diam., <i>R</i> | Drilling             |                   |                               | Minimum Fillet Radius, <i>r<sub>1</sub></i> |      |
|-------------------|--------------------------|--|-------|------------------------------|-----------------------------------|------------------------------------|-----------------------------|----------------------|-------------------|-------------------------------|---|------|
|                   |                          | WNF  | Blind |                              |                                   |                                    |                             | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |   |      |
| 26                | 38.25                    | 3.07   | 3.25  | 7.19                         | 28.38                             | 26.00                              | 29.50                       | 34.50                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 0.38 |
| 28                | 40.75                    | 3.32   | 3.50  | 7.69                         | 30.50                             | 28.00                              | 31.50                       | 37.00                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 0.44 |
| 30                | 43.00                    | 3.57   | 3.69  | 8.19                         | 32.56                             | 30.00                              | 33.75                       | 39.25                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 0.44 |
| 32                | 45.25                    | 3.82   | 3.88  | 8.69                         | 34.69                             | 32.00                              | 36.00                       | 41.50                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.44 |
| 34                | 47.50                    | 3.94   | 4.07  | 9.07                         | 36.88                             | 34.00                              | 38.00                       | 43.50                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.50 |
| 36                | 50.00                    | 4.07   | 4.32  | 9.44                         | 39.00                             | 36.00                              | 40.25                       | 46.00                | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.50 |
| 38                | 46.00                    | 4.19   | 4.19  | 7.06                         | 39.12                             | 38.00                              | 40.50                       | 43.00                | 32                | 1 <sup>5</sup> / <sub>8</sub> | 1 <sup>1</sup> / <sub>2</sub>               | 0.50 |
| 40                | 48.75                    | 4.44   | 4.44  | 7.56                         | 41.25                             | 40.00                              | 42.75                       | 45.50                | 32                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 0.50 |
| 42                | 50.75                    | 4.63   | 4.63  | 7.82                         | 43.25                             | 42.00                              | 44.75                       | 47.50                | 32                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub>               | 0.50 |
| 44                | 53.25                    | 4.82   | 4.82  | 8.06                         | 45.25                             | 44.00                              | 47.00                       | 49.75                | 32                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 0.50 |
| 46                | 55.75                    | 5.00   | 5.00  | 8.44                         | 47.38                             | 46.00                              | 49.00                       | 52.00                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.50 |
| 48                | 57.75                    | 5.19   | 5.19  | 8.75                         | 49.38                             | 48.00                              | 51.25                       | 54.00                | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.50 |
| 50                | 60.25                    | 5.44   | 5.44  | 9.07                         | 51.38                             | 50.00                              | 53.50                       | 56.25                | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.50 |
| 52                | 62.25                    | 5.63   | 5.63  | 9.32                         | 53.38                             | 52.00                              | 55.50                       | 58.25                | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.50 |
| 54                | 65.25                    | 5.94   | 5.94  | 9.88                         | 55.50                             | 54.00                              | 57.75                       | 61.00                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.50 |
| 56                | 67.25                    | 6.00   | 6.00  | 10.19                        | 57.62                             | 56.00                              | 59.75                       | 63.00                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.50 |
| 58                | 69.25                    | 6.19   | 6.19  | 10.44                        | 59.62                             | 58.00                              | 62.00                       | 65.00                | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.50 |
| 60                | 71.25                    | 6.38   | 6.38  | 10.69                        | 61.62                             | 60.00                              | 64.00                       | 67.00                | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.50 |

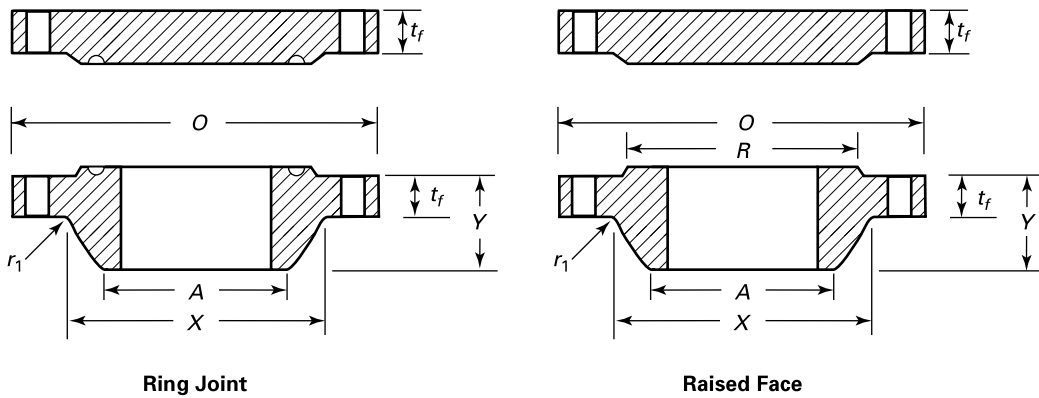
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-31 Dimensions of Class 400 Series A Flanges



| Nominal Pipe Size | O.D. of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> [Note (1)] |       | Length Through Hub, <i>Y</i> | Diam. of Hub, <i>X</i> [Note (2)] | Hub Diam. Top, <i>A</i> [Note (3)] | Raised Face Diam., <i>R</i> | Drilling             |                   |                               | Minimum Fillet Radius, <i>r<sub>1</sub></i> |               |
|-------------------|--------------------------|--|-------|------------------------------|-----------------------------------|------------------------------------|-----------------------------|----------------------|-------------------|-------------------------------|---|---------------|
|                   |                          | WNF  | Blind |                              |                                   |                                    |                             | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |   | Diam. of Bolt |
| 26                | 38.25                    | 3.50   | 3.88  | 7.62                         | 28.62                             | 26.00                              | 29.50                       | 34.50                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 0.44          |
| 28                | 40.75                    | 3.75   | 4.12  | 8.12                         | 30.81                             | 28.00                              | 31.50                       | 37.00                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.50          |
| 30                | 43.00                    | 4.00   | 4.38  | 8.62                         | 32.94                             | 30.00                              | 33.75                       | 39.25                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.50          |
| 32                | 45.25                    | 4.25   | 4.56  | 9.12                         | 35.00                             | 32.00                              | 36.00                       | 41.50                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.50          |
| 34                | 47.50                    | 4.38   | 4.81  | 9.50                         | 37.19                             | 34.00                              | 38.00                       | 43.50                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.56          |
| 36                | 50.00                    | 4.50   | 5.06  | 9.88                         | 39.38                             | 36.00                              | 40.25                       | 46.00                | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.56          |
| 38                | 47.50                    | 4.88   | 4.88  | 8.12                         | 39.50                             | 38.00                              | 40.75                       | 44.00                | 32                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub>               | 0.56          |
| 40                | 50.00                    | 5.12   | 5.12  | 8.50                         | 41.50                             | 40.00                              | 43.00                       | 46.25                | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.56          |
| 42                | 52.00                    | 5.25   | 5.25  | 8.81                         | 43.62                             | 42.00                              | 45.00                       | 48.25                | 32                | 2                             | 1 <sup>7</sup> / <sub>8</sub>               | 0.56          |
| 44                | 54.50                    | 5.50   | 5.50  | 9.18                         | 45.62                             | 44.00                              | 47.25                       | 50.50                | 32                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.56          |
| 46                | 56.75                    | 5.75   | 5.75  | 9.62                         | 47.75                             | 46.00                              | 49.50                       | 52.75                | 36                | 2 <sup>1</sup> / <sub>8</sub> | 2   | 0.56          |
| 48                | 59.50                    | 6.00   | 6.00  | 10.12                        | 49.88                             | 48.00                              | 51.50                       | 55.25                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.56          |
| 50                | 61.75                    | 6.19   | 6.25  | 10.56                        | 52.00                             | 50.00                              | 53.62                       | 57.50                | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.56          |
| 52                | 63.75                    | 6.38   | 6.44  | 10.88                        | 54.00                             | 52.00                              | 55.62                       | 59.50                | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub>               | 0.56          |
| 54                | 67.00                    | 6.69   | 6.75  | 11.38                        | 56.12                             | 54.00                              | 57.88                       | 62.25                | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 0.56          |
| 56                | 69.00                    | 6.88   | 6.94  | 11.75                        | 58.25                             | 56.00                              | 60.12                       | 64.25                | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 0.56          |
| 58                | 71.00                    | 7.00   | 7.12  | 12.06                        | 60.25                             | 58.00                              | 62.12                       | 66.25                | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 0.56          |
| 60                | 74.25                    | 7.31   | 7.44  | 12.56                        | 62.38                             | 60.00                              | 64.38                       | 69.00                | 32                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub>               | 0.56          |

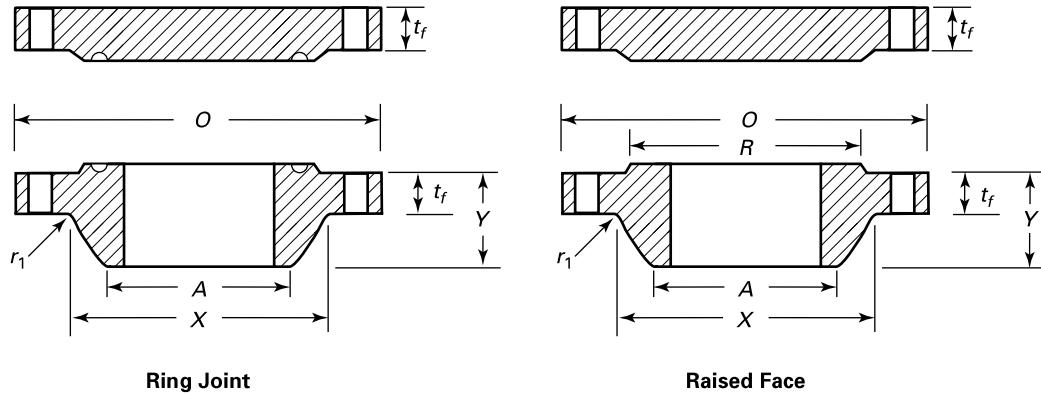
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-32 Dimensions of Class 600 Series A Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |               |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|---------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |                               | Diam. of Bolt |
| 26                | 40.00               | 4.25  | 4.94  | 8.75                    | 29.44                        | 26.00                         | 29.50                  | 36.00                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 0.50          |
| 28                | 42.25               | 4.38  | 5.19  | 9.25                    | 31.62                        | 28.00                         | 31.50                  | 38.00                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 0.50          |
| 30                | 44.50               | 4.50  | 5.50  | 9.75                    | 33.94                        | 30.00                         | 33.75                  | 40.25                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 0.50          |
| 32                | 47.00               | 4.62  | 5.81  | 10.25                   | 36.12                        | 32.00                         | 36.00                  | 42.50                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.50          |
| 34                | 49.00               | 4.75  | 6.06  | 10.62                   | 38.31                        | 34.00                         | 38.00                  | 44.50                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.56          |
| 36                | 51.75               | 4.88  | 6.38  | 11.12                   | 40.62                        | 36.00                         | 40.25                  | 47.00                | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 38                | 50.00               | 6.00  | 6.12  | 10.00                   | 40.25                        | 38.00                         | 41.50                  | 45.75                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.56          |
| 40                | 52.00               | 6.25  | 6.38  | 10.38                   | 42.25                        | 40.00                         | 43.75                  | 47.75                | 32                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.56          |
| 42                | 55.25               | 6.62  | 6.75  | 11.00                   | 44.38                        | 42.00                         | 46.00                  | 50.50                | 28                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 44                | 57.25               | 6.81  | 7.00  | 11.38                   | 46.50                        | 44.00                         | 48.25                  | 52.50                | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 46                | 59.50               | 7.06  | 7.31  | 11.81                   | 48.62                        | 46.00                         | 50.25                  | 54.75                | 32                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 48                | 62.75               | 7.44  | 7.69  | 12.44                   | 50.75                        | 48.00                         | 52.50                  | 57.50                | 32                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub> | 0.56          |
| 50                | 65.75               | 7.75  | 8.00  | 12.94                   | 52.88                        | 50.00                         | 54.50                  | 60.00                | 28                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 0.56          |
| 52                | 67.75               | 8.00  | 8.25  | 13.25                   | 54.88                        | 52.00                         | 56.50                  | 62.00                | 32                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 0.56          |
| 54                | 70.00               | 8.25  | 8.56  | 13.75                   | 57.00                        | 54.00                         | 58.75                  | 64.25                | 32                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 0.56          |
| 56                | 73.00               | 8.56  | 8.88  | 14.25                   | 59.12                        | 56.00                         | 60.75                  | 66.75                | 32                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 0.62          |
| 58                | 75.00               | 8.75  | 9.12  | 14.56                   | 61.12                        | 58.00                         | 63.00                  | 68.75                | 32                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 0.62          |
| 60                | 78.50               | 9.19  | 9.56  | 15.31                   | 63.38                        | 60.00                         | 65.25                  | 71.75                | 28                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.69          |

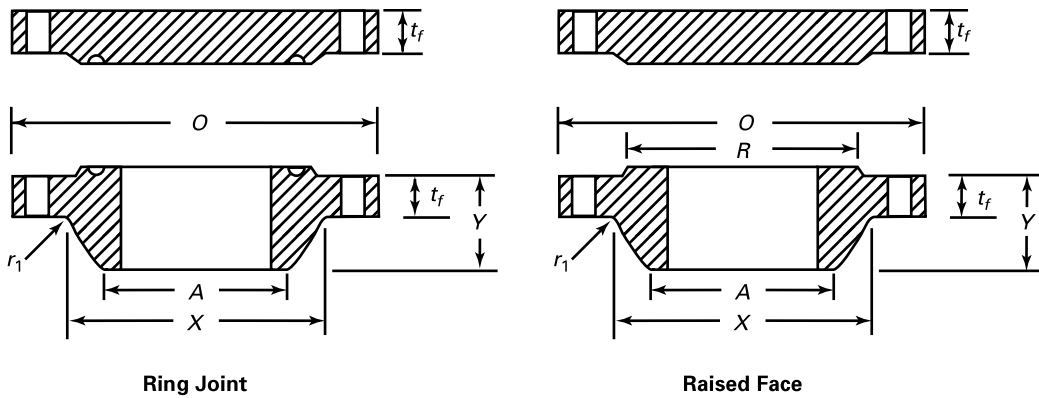
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-33 Dimensions of Class 900 Series A Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |               |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|---------------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |                               | Diam. of Bolt |
| 26                | 42.75               | 5.50  | 6.31  | 11.25                   | 30.50                        | 26.00                         | 29.50                  | 37.50                | 20                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub> | 0.44          |
| 28                | 46.00               | 5.62  | 6.75  | 11.75                   | 32.75                        | 28.00                         | 31.50                  | 40.25                | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 0.50          |
| 30                | 48.50               | 5.88  | 7.18  | 12.25                   | 35.00                        | 30.00                         | 33.75                  | 42.75                | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3                             | 0.50          |
| 32                | 51.75               | 6.25  | 7.62  | 13.00                   | 37.25                        | 32.00                         | 36.00                  | 45.50                | 20                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub> | 0.50          |
| 34                | 55.00               | 6.50  | 8.06  | 13.75                   | 39.62                        | 34.00                         | 38.00                  | 48.25                | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 36                | 57.50               | 6.75  | 8.44  | 14.25                   | 41.88                        | 36.00                         | 40.25                  | 50.75                | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.56          |
| 38                | 57.50               | 7.50  | 8.50  | 13.88                   | 42.25                        | 38.00                         | 43.25                  | 50.75                | 20                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.75          |
| 40                | 59.50               | 7.75  | 8.81  | 14.31                   | 44.38                        | 40.00                         | 45.75                  | 52.75                | 24                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.81          |
| 42                | 61.50               | 8.12  | 9.12  | 14.62                   | 46.31                        | 42.00                         | 47.75                  | 54.75                | 24                | 3 <sup>5</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>2</sub> | 0.81          |
| 44                | 64.88               | 8.44  | 9.56  | 15.38                   | 48.62                        | 44.00                         | 50.00                  | 57.62                | 24                | 3 <sup>7</sup> / <sub>8</sub> | 3 <sup>3</sup> / <sub>4</sub> | 0.88          |
| 46                | 68.25               | 8.88  | 10.06 | 16.18                   | 50.88                        | 46.00                         | 52.50                  | 60.50                | 24                | 4 <sup>1</sup> / <sub>8</sub> | 4                             | 0.88          |
| 48                | 70.25               | 9.19  | 10.38 | 16.50                   | 52.88                        | 48.00                         | 54.50                  | 62.50                | 24                | 4 <sup>1</sup> / <sub>8</sub> | 4                             | 0.94          |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...           |

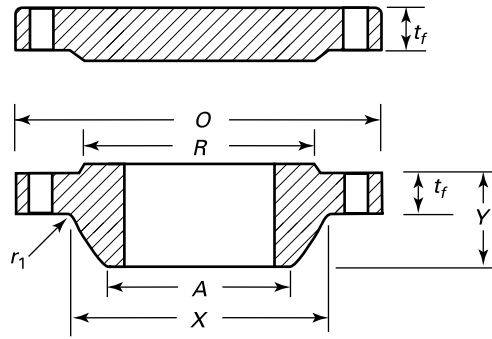
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-34 Dimensions of Class 75 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                    | Minimum Fillet Radius, $r_1$ |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|--------------------|------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole |                              |      |
| 26                | 30.00               | 1.25  | 1.25  | 2.25                    | 26.62                        | 26.06                         | 27.75                  | 28.50                | 36                | $\frac{3}{4}$      | $\frac{5}{8}$                | 0.31 |
| 28                | 32.00               | 1.25  | 1.25  | 2.38                    | 28.62                        | 28.06                         | 29.75                  | 30.50                | 40                | $\frac{3}{4}$      | $\frac{5}{8}$                | 0.31 |
| 30                | 34.00               | 1.25  | 1.25  | 2.50                    | 30.62                        | 30.06                         | 31.75                  | 32.50                | 44                | $\frac{3}{4}$      | $\frac{5}{8}$                | 0.31 |
| 32                | 36.00               | 1.32  | 1.38  | 2.69                    | 32.62                        | 32.06                         | 33.75                  | 34.50                | 48                | $\frac{3}{4}$      | $\frac{5}{8}$                | 0.31 |
| 34                | 38.00               | 1.32  | 1.44  | 2.82                    | 34.62                        | 34.06                         | 35.75                  | 36.50                | 52                | $\frac{3}{4}$      | $\frac{5}{8}$                | 0.31 |
| 36                | 40.69               | 1.38  | 1.61  | 3.32                    | 36.81                        | 36.06                         | 38.00                  | 39.06                | 40                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 38                | 42.69               | 1.44  | 1.69  | 3.44                    | 38.81                        | 38.06                         | 40.00                  | 41.06                | 40                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 40                | 44.69               | 1.44  | 1.69  | 3.57                    | 40.81                        | 40.06                         | 42.00                  | 43.06                | 44                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 42                | 46.69               | 1.50  | 1.82  | 3.69                    | 42.81                        | 42.06                         | 44.00                  | 45.06                | 48                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 44                | 49.25               | 1.63  | 1.88  | 4.07                    | 44.88                        | 44.06                         | 46.25                  | 47.38                | 36                | 1                  | $\frac{7}{8}$                | 0.38 |
| 46                | 51.25               | 1.69  | 1.94  | 4.19                    | 46.88                        | 46.06                         | 48.25                  | 49.38                | 40                | 1                  | $\frac{7}{8}$                | 0.38 |
| 48                | 53.25               | 1.75  | 2.07  | 4.32                    | 48.88                        | 48.06                         | 50.25                  | 51.38                | 44                | 1                  | $\frac{7}{8}$                | 0.38 |
| 50                | 55.25               | 1.82  | 2.13  | 4.50                    | 50.94                        | 50.06                         | 52.25                  | 53.38                | 44                | 1                  | $\frac{7}{8}$                | 0.38 |
| 52                | 57.38               | 1.82  | 2.19  | 4.69                    | 52.94                        | 52.06                         | 54.25                  | 55.50                | 48                | 1                  | $\frac{7}{8}$                | 0.38 |
| 54                | 59.38               | 1.88  | 2.32  | 4.88                    | 55.00                        | 54.06                         | 56.25                  | 57.50                | 48                | 1                  | $\frac{7}{8}$                | 0.38 |
| 56                | 62.00               | 1.94  | 2.38  | 5.25                    | 57.12                        | 56.06                         | 58.50                  | 59.88                | 40                | $1\frac{1}{8}$     | 1                            | 0.44 |
| 58                | 64.00               | 2.00  | 2.44  | 5.38                    | 59.12                        | 58.06                         | 60.50                  | 61.88                | 44                | $1\frac{1}{8}$     | 1                            | 0.44 |
| 60                | 66.00               | 2.13  | 2.57  | 5.63                    | 61.12                        | 60.06                         | 62.50                  | 63.88                | 44                | $1\frac{1}{8}$     | 1                            | 0.44 |

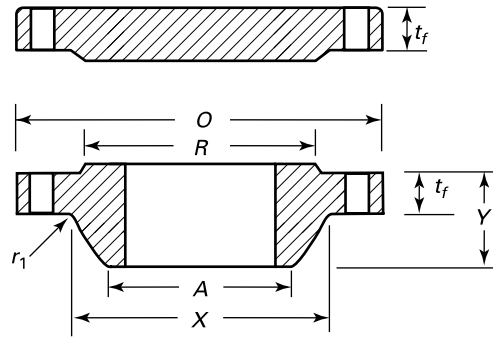
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-35 Dimensions of Class 150 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                    | Minimum Fillet Radius, $r_1$ |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|--------------------|------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole |                              |      |
| 26                | 30.94               | 1.57  | 1.69  | 3.44                    | 26.94                        | 26.06                         | 28.00                  | 29.31                | 36                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 28                | 32.94               | 1.69  | 1.82  | 3.69                    | 28.94                        | 28.06                         | 30.00                  | 31.31                | 40                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 30                | 34.94               | 1.69  | 1.94  | 3.88                    | 31.00                        | 30.06                         | 32.00                  | 33.31                | 44                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 32                | 37.06               | 1.75  | 2.07  | 4.19                    | 33.06                        | 32.06                         | 34.00                  | 35.44                | 48                | $\frac{7}{8}$      | $\frac{3}{4}$                | 0.38 |
| 34                | 39.56               | 1.88  | 2.19  | 4.28                    | 35.12                        | 34.06                         | 36.25                  | 37.69                | 40                | 1                  | $\frac{7}{8}$                | 0.38 |
| 36                | 41.62               | 2.00  | 2.25  | 4.57                    | 37.19                        | 36.06                         | 38.25                  | 39.75                | 44                | 1                  | $\frac{7}{8}$                | 0.38 |
| 38                | 44.25               | 2.07  | 2.44  | 4.82                    | 39.25                        | 38.12                         | 40.25                  | 42.12                | 40                | $1\frac{1}{8}$     | 1                            | 0.38 |
| 40                | 46.25               | 2.13  | 2.57  | 5.00                    | 41.31                        | 40.12                         | 42.50                  | 44.12                | 44                | $1\frac{1}{8}$     | 1                            | 0.38 |
| 42                | 48.25               | 2.25  | 2.63  | 5.19                    | 43.38                        | 42.12                         | 44.50                  | 46.12                | 48                | $1\frac{1}{8}$     | 1                            | 0.44 |
| 44                | 50.25               | 2.32  | 2.75  | 5.32                    | 45.38                        | 44.12                         | 46.50                  | 48.12                | 52                | $1\frac{1}{8}$     | 1                            | 0.44 |
| 46                | 52.81               | 2.38  | 2.88  | 5.63                    | 47.44                        | 46.12                         | 48.62                  | 50.56                | 40                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.44 |
| 48                | 54.81               | 2.50  | 3.00  | 5.82                    | 49.50                        | 48.12                         | 50.75                  | 52.56                | 44                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.44 |
| 50                | 56.81               | 2.63  | 3.13  | 6.00                    | 51.50                        | 50.12                         | 52.75                  | 54.56                | 48                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.44 |
| 52                | 58.81               | 2.69  | 3.25  | 6.13                    | 53.56                        | 52.12                         | 54.75                  | 56.56                | 52                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.44 |
| 54                | 61.00               | 2.75  | 3.38  | 6.32                    | 55.62                        | 54.12                         | 56.75                  | 58.75                | 56                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.44 |
| 56                | 63.00               | 2.82  | 3.50  | 6.50                    | 57.69                        | 56.12                         | 58.75                  | 60.75                | 60                | $1\frac{1}{4}$     | $1\frac{1}{8}$               | 0.56 |
| 58                | 65.94               | 2.88  | 3.62  | 6.82                    | 59.69                        | 58.12                         | 60.75                  | 63.44                | 48                | $1\frac{3}{8}$     | $1\frac{1}{4}$               | 0.56 |
| 60                | 67.94               | 2.94  | 3.75  | 7.00                    | 61.81                        | 60.12                         | 63.00                  | 65.44                | 52                | $1\frac{3}{8}$     | $1\frac{1}{4}$               | 0.56 |

GENERAL NOTES:

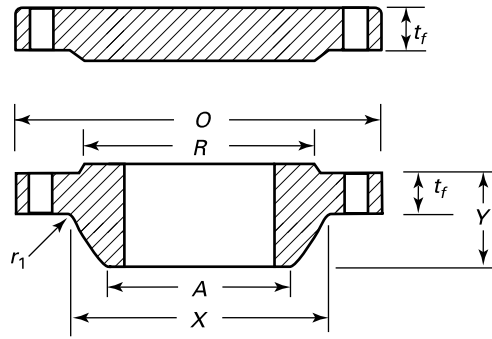
- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.



**Table I-36 Dimensions of Class 300 Series B Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                    | Minimum Fillet Radius, $r_1$ |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|--------------------|------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole |                              |      |
| 26                | 34.12               | 3.44  | 3.44  | 5.63                    | 27.62                        | 26.19                         | 29.00                  | 31.62                | 32                | $1\frac{3}{8}$     | $1\frac{1}{4}$               | 0.56 |
| 28                | 36.25               | 3.44  | 3.44  | 5.81                    | 29.75                        | 28.19                         | 31.00                  | 33.75                | 36                | $1\frac{3}{8}$     | $1\frac{1}{4}$               | 0.56 |
| 30                | 39.00               | 3.63  | 3.63  | 6.16                    | 32.00                        | 30.25                         | 33.25                  | 36.25                | 36                | $1\frac{1}{2}$     | $1\frac{3}{8}$               | 0.56 |
| 32                | 41.50               | 4.00  | 4.00  | 6.56                    | 34.00                        | 32.25                         | 35.50                  | 38.50                | 32                | $1\frac{5}{8}$     | $1\frac{1}{2}$               | 0.62 |
| 34                | 43.62               | 4.00  | 4.00  | 6.75                    | 36.12                        | 34.25                         | 37.50                  | 40.62                | 36                | $1\frac{5}{8}$     | $1\frac{1}{2}$               | 0.62 |
| 36                | 46.12               | 4.00  | 4.00  | 7.06                    | 38.00                        | 36.25                         | 39.75                  | 42.88                | 32                | $1\frac{3}{4}$     | $1\frac{5}{8}$               | 0.62 |
| 38                | 48.12               | 4.31  | 4.31  | 7.50                    | 40.00                        | 38.25                         | 41.75                  | 44.88                | 36                | $1\frac{3}{4}$     | $1\frac{5}{8}$               | 0.62 |
| 40                | 50.12               | 4.50  | 4.50  | 7.75                    | 42.00                        | 40.25                         | 43.88                  | 46.88                | 40                | $1\frac{3}{4}$     | $1\frac{5}{8}$               | 0.62 |
| 42                | 52.50               | 4.63  | 4.63  | 8.00                    | 44.00                        | 42.31                         | 46.00                  | 49.00                | 36                | $1\frac{7}{8}$     | $1\frac{3}{4}$               | 0.62 |
| 44                | 54.50               | 4.94  | 4.94  | 8.38                    | 46.19                        | 44.31                         | 48.00                  | 51.00                | 40                | $1\frac{7}{8}$     | $1\frac{3}{4}$               | 0.62 |
| 46                | 57.50               | 5.00  | 5.06  | 8.69                    | 48.38                        | 46.31                         | 50.00                  | 53.75                | 36                | 2                  | $1\frac{7}{8}$               | 0.62 |
| 48                | 59.50               | 5.00  | 5.25  | 8.75                    | 50.31                        | 48.31                         | 52.25                  | 55.75                | 40                | 2                  | $1\frac{7}{8}$               | 0.62 |
| 50                | 61.50               | 5.38  | 5.44  | 9.19                    | 52.38                        | 50.31                         | 54.25                  | 57.75                | 44                | 2                  | $1\frac{7}{8}$               | 0.62 |
| 52                | 63.50               | 5.56  | 5.61  | 9.50                    | 54.44                        | 52.31                         | 56.25                  | 59.75                | 48                | 2                  | $1\frac{7}{8}$               | 0.62 |
| 54                | 65.88               | 5.32  | 5.81  | 9.38                    | 56.50                        | 54.31                         | 58.25                  | 62.12                | 48                | 2                  | $1\frac{7}{8}$               | 0.62 |
| 56                | 69.50               | 6.00  | 6.12  | 10.50                   | 58.81                        | 56.31                         | 60.50                  | 65.00                | 36                | $2\frac{3}{8}$     | $2\frac{1}{4}$               | 0.69 |
| 58                | 71.94               | 6.00  | 6.31  | 10.75                   | 60.94                        | 58.31                         | 62.75                  | 67.44                | 40                | $2\frac{3}{8}$     | $2\frac{1}{4}$               | 0.69 |
| 60                | 73.94               | 5.88  | 6.50  | 10.63                   | 62.94                        | 60.31                         | 65.00                  | 69.44                | 40                | $2\frac{3}{8}$     | $2\frac{1}{4}$               | 0.69 |

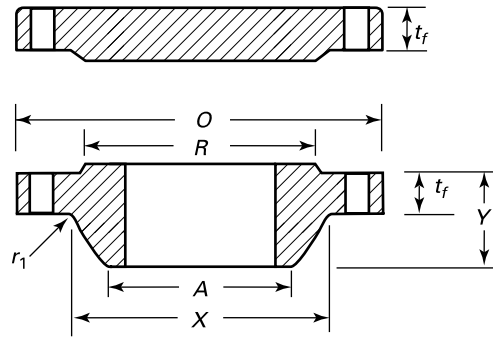
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-37 Dimensions of Class 400 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                    | Minimum Fillet Radius, $r_1$ |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|--------------------|------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole |                              |      |
| 26                | 33.50               | 3.50  | 3.50  | 5.88                    | 27.12                        | 26.00                         | 28.00                  | 30.75                | 28                | 1½                 | 1⅜                           | 0.44 |
| 28                | 36.00               | 3.75  | 3.75  | 6.25                    | 29.12                        | 28.00                         | 30.00                  | 33.00                | 24                | 1⅝                 | 1½                           | 0.50 |
| 30                | 38.25               | 4.00  | 4.00  | 6.69                    | 31.25                        | 30.00                         | 32.25                  | 35.25                | 28                | 1⅝                 | 1½                           | 0.50 |
| 32                | 40.75               | 4.25  | 4.25  | 7.06                    | 33.25                        | 32.00                         | 34.38                  | 37.50                | 28                | 1¾                 | 1⅝                           | 0.50 |
| 34                | 42.75               | 4.38  | 4.38  | 7.38                    | 35.38                        | 34.00                         | 36.50                  | 39.50                | 32                | 1¾                 | 1⅝                           | 0.56 |
| 36                | 45.50               | 4.69  | 4.69  | 7.88                    | 37.50                        | 36.00                         | 38.62                  | 42.00                | 28                | 1⅞                 | 1¾                           | 0.56 |
| 38                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 40                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 42                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 44                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 46                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 48                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                | ...                          | ...  |

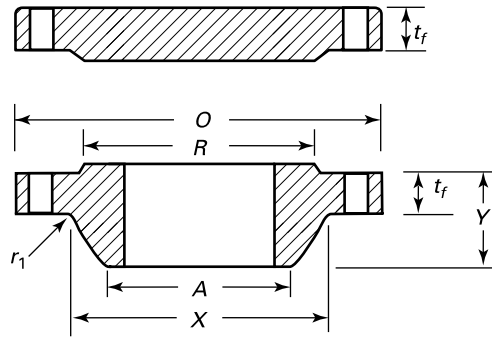
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

**Table I-38 Dimensions of Class 600 Series B Flanges**



| Nominal Pipe Size | O.D. of Flange, $O$ | Minimum Thickness of Flange, $t_f$ [Note (1)] |       | Length Through Hub, $Y$ | Diam. of Hub, $X$ [Note (2)] | Hub Diam. Top, $A$ [Note (3)] | Raised Face Diam., $R$ | Drilling             |                   |                               | Minimum Fillet Radius, $r_1$  |      |
|-------------------|---------------------|---|-------|-------------------------|------------------------------|-------------------------------|------------------------|----------------------|-------------------|-------------------------------|-------------------------------|------|
|                   |                     | WNF   | Blind |                         |                              |                               |                        | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |                               |      |
| 26                | 35.00               | 4.38  | 4.38  | 7.12                    | 27.50                        | 26.00                         | 28.62                  | 31.75                | 28                | 1 <sup>3</sup> / <sub>4</sub> | 1 <sup>5</sup> / <sub>8</sub> | 0.50 |
| 28                | 37.50               | 4.56  | 4.56  | 7.50                    | 29.62                        | 28.00                         | 30.88                  | 34.00                | 28                | 1 <sup>7</sup> / <sub>8</sub> | 1 <sup>3</sup> / <sub>4</sub> | 0.50 |
| 30                | 40.25               | 4.94  | 5.00  | 8.06                    | 31.75                        | 30.00                         | 33.12                  | 36.50                | 28                | 2                             | 1 <sup>7</sup> / <sub>8</sub> | 0.50 |
| 32                | 42.75               | 5.12  | 5.31  | 8.50                    | 33.88                        | 32.00                         | 35.25                  | 38.75                | 28                | 2 <sup>1</sup> / <sub>8</sub> | 2                             | 0.50 |
| 34                | 45.75               | 5.56  | 5.68  | 9.19                    | 36.00                        | 34.00                         | 37.50                  | 41.50                | 24                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.56 |
| 36                | 47.75               | 5.75  | 5.94  | 9.56                    | 38.12                        | 36.00                         | 39.75                  | 43.50                | 28                | 2 <sup>3</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>4</sub> | 0.56 |
| 38                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 40                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 42                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 44                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 46                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 48                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 50                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 52                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 54                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 56                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 58                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |
| 60                | ...                 | ...   | ...   | ...                     | ...                          | ...                           | ...                    | ...                  | ...               | ...                           | ...                           | ...  |

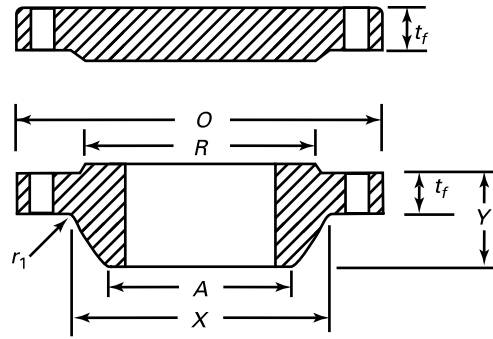
**GENERAL NOTES:**

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

**NOTES:**

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

Table I-39 Dimensions of Class 900 Series B Flanges



| Nominal Pipe Size | O.D. of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> [Note (1)] |       | Length Through Hub, <i>Y</i> | Diam. of Hub, <i>X</i> [Note (2)] | Hub Diam. Top, <i>A</i> [Note (3)] | Raised Face Diam., <i>R</i> | Drilling             |                   |                               | Minimum Fillet Radius, <i>r<sub>1</sub></i> |      |
|-------------------|--------------------------|--|-------|------------------------------|-----------------------------------|------------------------------------|-----------------------------|----------------------|-------------------|-------------------------------|---|------|
|                   |                          | WNF  | Blind |                              |                                   |                                    |                             | Diam. of Bolt Circle | No. of Bolt Holes | Diam. of Bolt Hole            |   |      |
| 26                | 40.25                    | 5.31   | 6.06  | 10.19                        | 29.25                             | 26.00                              | 30.00                       | 35.50                | 20                | 2 <sup>5</sup> / <sub>8</sub> | 2 <sup>1</sup> / <sub>2</sub>               | 0.44 |
| 28                | 43.50                    | 5.81   | 6.56  | 10.88                        | 31.38                             | 28.00                              | 32.25                       | 38.25                | 20                | 2 <sup>7</sup> / <sub>8</sub> | 2 <sup>3</sup> / <sub>4</sub>               | 0.50 |
| 30                | 46.50                    | 6.12   | 6.93  | 11.38                        | 33.50                             | 30.00                              | 34.50                       | 40.75                | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3   | 0.50 |
| 32                | 48.75                    | 6.31   | 7.31  | 11.94                        | 35.75                             | 32.00                              | 36.50                       | 43.00                | 20                | 3 <sup>1</sup> / <sub>8</sub> | 3   | 0.50 |
| 34                | 51.75                    | 6.75   | 7.68  | 12.56                        | 37.88                             | 34.00                              | 39.00                       | 45.50                | 20                | 3 <sup>3</sup> / <sub>8</sub> | 3 <sup>1</sup> / <sub>4</sub>               | 0.56 |
| 36                | 53.00                    | 6.81   | 7.94  | 12.81                        | 40.00                             | 36.00                              | 40.50                       | 47.25                | 24                | 3 <sup>1</sup> / <sub>8</sub> | 3   | 0.56 |
| 38                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 40                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 42                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 44                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 46                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 48                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 50                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 52                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 54                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 56                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 58                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |
| 60                | ...                      | ...  | ...   | ...                          | ...                               | ...                                | ...                         | ...                  | ...               | ...                           | ...   | ...  |

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.1.
- (d) For flange bolt holes, see para. 6.2.
- (e) For spot facing, see para. 6.3.
- (f) The bore is to be specified by the purchaser. Tolerances in para. 7.3.2 apply.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) Dimensions for Classes 400, 600, and 900 NPS 38 and larger for Series B flanges are the same as for the Series A flanges.

NOTES:

- (1) The minimum flange thickness does not include the raised face thickness (see para. 6.1.1).
- (2) This dimension is for the large end of hub, which may be straight or tapered.
- (3) For welding and bevel, see para. 6.4.

(17)

## MANDATORY APPENDIX II REFERENCES

The following is a list of standards and specifications referenced in this Standard. Products covered by each ASTM specification are listed for convenience. For ASME Codes and Standards referenced hereunder, the latest edition in effect at the time this edition of this Standard is specified, may be used. (See specifications for exact titles and detailed contents.) Materials manufactured to other editions of the referenced ASTM specifications may be used to manufacture fittings meeting the requirements of this Standard as long as the fitting manufacturer verifies that the material meets the requirements of the referenced edition of the ASTM specification.

- ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)
- ASME B1.20.1, Pipe Threads, General Purpose (Inch)
- ASME B16.5, Pipe Flanges and Flanged Fittings: NPS  $\frac{1}{2}$  Through NPS 24
- ASME B16.20, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
- ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
- ASME B16.34, Valves — Flanged, Threaded, and Welding End
- ASME B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
- ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
- ASME B18.31.2, Continuous and Double-End Studs (Inch Series)
- ASME B31.3, Process Piping
- ASME B46.1, Surface Texture, Surface Roughness, Waviness, and Lay
- ASME Boiler and Pressure Vessel Code:  
Section I, Rules for Construction of Power Boilers  
Section II, Materials  
Section III, Rules for Construction of Nuclear Facility Components  
Section VIII, Divisions 1 & 2, Rules for Construction of Pressure Vessels
- Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)
- ASTM A105-2010a, Carbon Steel Forgings for Piping Applications
- ASTM A182-2010a, Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A193-2010a, Alloy Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications
- ASTM A194-2010a, Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- ASTM A203-1997(R07)<sup>e1</sup>, Pressure Vessel Plates, Alloy Steel, Nickel
- ASTM A204-2003(R07), Pressure Vessel Plates, Alloy Steel, Molybdenum
- ASTM A216-2008, Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- ASTM A217-2010, Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
- ASTM A240-2010b, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- ASTM A307-2010, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- ASTM A320-2010a, Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
- ASTM A350-2010, Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
- ASTM A351-2010, Castings, Austenitic, for Pressure-Containing Parts
- ASTM A352-2006, Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
- ASTM A354-2007a, Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- ASTM A387-2010, Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
- ASTM A449-2010, Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
- ASTM A453-2010, High Temperature Bolting, With Expansion Coefficients Comparable to Austenitic Steels
- ASTM A515-2010, Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
- ASTM A516-2010, Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

ASTM A537-2008, Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel

ASTM A540-2010a, Alloy-Steel Bolting for Special Applications

ASTM E29-2008, Using Significant Digits in Test Data to Determine Conformance With Specifications

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

ISO 9000:2000, Quality management systems — Fundamentals and vocabulary<sup>1</sup>

ISO 9001:2000, Quality management systems — Requirements<sup>1</sup>

ISO 9004:2009, Managing for the sustained success of an organization — A quality management approach<sup>1</sup>

Publisher: International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

MSS SP-9-2008, Spot-Facing for Bronze, Iron, and Steel Flanges

MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges, and Unions

MSS SP-44-2010, Steel Pipe Line Flanges

MSS SP-45-2003(R2008), Bypass and Drain Connection

MSS SP-61-2009, Pressure Testing of Valves

Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180 (www.msshq.org)

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<sup>1</sup> May also be obtained from the American National Standards Institute (ANSI), 25 West 43<sup>rd</sup> Street, New York, NY 10036.

# NONMANDATORY APPENDIX A

## METHODS USED FOR ESTABLISHING PRESSURE-TEMPERATURE RATINGS

### A-1 GENERAL CONSIDERATIONS

#### A-1.1 Introduction

Pressure-temperature ratings for this Standard have been determined by the procedures described in this Nonmandatory Appendix. These procedures are counter-part to those identified in ASME B16.34. The primary considerations in establishing ratings are component dimensions and material properties to sustain pressure and other loads.<sup>1</sup> Other considerations affecting or limiting the ratings include

- (a) stresses in flanges resulting from bolt-up necessary to maintain a gasket seal
- (b) distortion of flanges and flanged fittings due to loads transmitted through attached piping
- (c) limitations applying primarily to flanged components (e.g., valves), but imposed also on flanges in order to preserve compatible ratings

#### A-1.2 Material Properties

The pressure-temperature rating method uses allowable stress, ultimate tensile strength, and yield strength values from reference ASME Boiler and Pressure Vessel Code, Section II, Part D. For materials listed herein that have ratings either at temperature values that are above those shown in a reference Code Section or that are not listed in any of the reference Code Sections, the allowable stress, ultimate tensile strength, and yield strength data have been provided directly by the ASME Boiler and Pressure Vessel Subcommittee on Materials.

#### A-1.3 Material Groups

Materials are grouped in [Table 1](#) based on identical or closely matched allowable stress and yield strength values. When these values are not identical for each material listed, the lowest value has been used. Note that material groups in this Standard are not numbered consecutively. The unlisted numbers, numbers that are not part of this Standard, may be found in the materials tables of ASME B16.34.

<sup>1</sup>This method is appropriate for materials listed in [Table 1](#). It may not be appropriate for other materials.

### A-2 PRESSURE-TEMPERATURE RATING METHOD

#### A-2.1 Rating Equation Class 300 and Higher

Pressure-temperature ratings for Class 300 and higher components, of materials listed to those in [Table 1](#) were established by [eq. \(A-1\)](#).

$$p_t = \frac{C_1 S_1}{8 \cdot 750} P_r \leq p_c \quad (\text{A-1})$$

$C_1 = 10$  when  $S_1$  is expressed in MPa units and the resultant  $p_t$  will be in bar units ( $C_1 = 1$  when  $S_1$  is expressed in psi units and the resultant  $p_t$  will be in psi units)

$P_r$  = pressure rating class index. For all designations Class 300 and above,  $P_r$  is equal to the class designation (e.g., for Class 300,  $P_r = 300$ ). For Classes 75 and 150, see [para. A-2.4](#).

$p_c$  = ceiling pressure, bar (psi), at temperature  $T$  as specified in [para. A-3](#)

$p_t$  = rated working pressure, bar (psi), for the specified material at temperature  $T$

$S_1$  = selected stress, MPa (psi) for the specified material at temperature  $T$ . The value of  $S_1$  shall be established as described in [paras. A-2.2, A-2.3, and A-2.4](#).

#### A-2.2 Ratings for Group 1 Materials

The selected stress for Group 1 materials in [Table 1](#) is determined as follows:

(a) At temperatures below the creep range,  $S_1$  shall be equal to or less than

(1) 60% of the specified minimum yield strength at 38°C (100°F)

(2) 60% of the yield strength at temperature  $T$

(3) 1.25 times 25% of the ultimate tensile strength value at temperature  $T$ , as listed in ASME Boiler and Pressure Vessel Code, Section II, Part D, for either Section I or Section VIII, Division 1

(b) At temperatures in the creep range, the value of  $S_1$  shall be the allowable stress at temperature  $T$ , as listed in ASME Boiler and Pressure Vessel Code, Section II, Part D, for either Section I or Section VIII, Division 1, however, not exceeding 60% of the listed yield strength at temperature.

(c) In no case shall the selected stress value increase with increasing temperature.

(d) The creep range is considered to be at temperatures in excess of 370°C (700°F) for Group 1 materials.

(e) When the allowable stresses listed for the reference ASME Boiler and Pressure Vessel Code Section show a higher and lower value for allowable stress and the higher value is noted to the effect that these stress values exceed two-thirds of the yield strength at temperature, then the lower shall be used. If lower allowable stress values do not appear and it is noted in the allowable stress table that the allowable stress values exceed two-thirds of the yield strength at temperature, then the allowable stress values used shall be determined as two-thirds of the tabulated yield strength at temperature.

(f) Yield strength shall be as listed in ASME Boiler and Pressure Vessel Code, Section II, Part D, for either Section III or Section VIII, Division 2.

(g) Allowable stress values listed in ASME Boiler and Pressure Vessel Code, Section II, Part D, for Section III, Class 2 or Class 3 values may only be used for a material not listed for either Section I or Section VIII, Division 1.

### A-2.3 Method for Group 2 Materials

Pressure–temperature ratings for Class 300 and higher, of materials corresponding to those in Material Groups 2 of Table 1, are established by the method of paras. A-2.1 and A-2.2, except that in paras. A-2.2(a)(1) and A-2.2(a)(2), the 60% factor shall be changed to 70%. For Group 2 materials, the creep range is considered to be at temperatures in excess of 510°C (950°F) unless the material properties indicate that lower temperatures should be used.

### A-2.4 Method for Class 75 and 150 — All Materials

Pressure–temperature ratings for Class 75 and 150 rating designations are established by the method given for the related materials in paras. A-2.1, A-2.2, and A-2.3, subject to the following exceptions:

(a) the value of  $P_r$ , the pressure class rating index, in eq. (A-1) for Class 75 shall be 57.5 and for Class 150 shall be 115

(b) the value for  $S_1$ , the selected stress, MPa (psi), for the specific material at temperature  $T$  shall be in accordance with the requirements of either para. A-2.1 or A-2.2, as applicable

(c) the value of  $p_t$ , the rated working pressure, bar (psi), for Class 150 shall not exceed values at temperature  $T$  as given by eq. (A-2)

$$p_t \leq C_2 - C_3 T \quad (\text{A-2})$$

$T$  = material temperature, °C (°F)

For Class 150

$C_2$  = 21.41 with  $T$  expressed in °C, the resultant  $p_t$  will be in bar units

= 320 with  $T$  expressed in °F, the resultant  $p_t$  will be in psi units

$C_3$  = 0.03724 with  $T$  expressed in °C, the resultant  $p_t$  will be in bar units

= 0.3 with  $T$  expressed in °F, the resultant  $p_t$  will be in psi units

For Class 75

$C_2$  = 10.71 with  $T$  expressed in °C, the resultant  $p_t$  will be in bar units

= 160 with  $T$  expressed in °F, the resultant  $p_t$  will be in psi units

$C_3$  = 0.01862 with  $T$  expressed in °C, the resultant  $p_t$  will be in bar units

= 0.15 with  $T$  expressed in °F, the resultant  $p_t$  will be in psi units

The value of  $T$  in eq. (A-2) shall not exceed 538°C (1,000°F). For values of  $T$  less than 38°C (100°F), use  $T$  equal to 38°C (100°F) in eq. (A-2).

## A-3 MAXIMUM RATINGS

The rules for establishing pressure–temperature ratings include consideration of ceiling pressures that effectively set limits on the selected stress. The ceiling pressure–temperature values set an upper bound for high strength materials and are imposed to limit deflection. Ceiling pressure values are listed in Tables A-1 and A-2. Ratings in excess of these ceiling values are not permitted under this Standard.



**Table A-1 Rating Ceiling Values in bar**

| Temperature, °C | Ceiling Pressure by Classes, bar |            |      |      |       |       |
|-----------------|----------------------------------|------------|------|------|-------|-------|
|                 | 75                               | 150        | 300  | 400  | 600   | 900   |
| -29 to 38       | 10.0                             | 20.0       | 51.7 | 68.9 | 103.4 | 155.1 |
| 50              | 9.8                              | 19.5       | 51.7 | 68.9 | 103.4 | 155.1 |
| 100             | 8.9                              | 17.7       | 51.5 | 68.7 | 103.0 | 154.6 |
| 150             | 7.9                              | 15.8       | 50.3 | 66.8 | 100.3 | 150.6 |
| 200             | 6.9                              | 13.8       | 48.6 | 64.8 | 97.2  | 145.8 |
| 250             | 6.1                              | 12.1       | 46.3 | 61.7 | 92.7  | 139.0 |
| 300             | 5.1                              | 10.2       | 42.9 | 57.0 | 85.7  | 128.6 |
| 325             | 4.7                              | 9.3        | 41.4 | 55.0 | 82.6  | 124.0 |
| 350             | 4.2                              | 8.4        | 40.3 | 53.6 | 80.4  | 120.7 |
| 375             | [Note (1)]                       | 7.4        | 38.9 | 51.6 | 77.6  | 116.5 |
| 400             | ...                              | 6.5        | 36.5 | 48.9 | 73.3  | 109.8 |
| 425             | ...                              | 5.5        | 35.2 | 46.5 | 70.0  | 105.1 |
| 450             | ...                              | 4.6        | 33.7 | 45.1 | 67.7  | 101.4 |
| 475             | ...                              | 3.7        | 31.7 | 42.3 | 63.4  | 95.1  |
| 500             | ...                              | 2.8        | 28.2 | 37.6 | 56.5  | 84.7  |
| 525             | ...                              | 1.9        | 25.8 | 34.4 | 51.6  | 77.4  |
| 538             | ...                              | 1.4        | 25.2 | 33.4 | 50.0  | 75.2  |
| 550             | ...                              | [Note (2)] | 25.0 | 33.3 | 49.8  | 74.8  |
| 575             | ...                              | ...        | 24.0 | 31.9 | 47.9  | 71.8  |
| 600             | ...                              | ...        | 21.6 | 28.6 | 42.9  | 64.2  |
| 625             | ...                              | ...        | 18.3 | 24.3 | 36.6  | 54.9  |
| 650             | ...                              | ...        | 14.1 | 18.9 | 28.1  | 42.5  |
| 675             | ...                              | ...        | 12.4 | 16.9 | 25.2  | 37.6  |
| 700             | ...                              | ...        | 10.1 | 13.4 | 20.0  | 29.8  |
| 725             | ...                              | ...        | 7.9  | 10.5 | 15.4  | 23.2  |
| 750             | ...                              | ...        | 5.9  | 7.9  | 11.7  | 17.6  |
| 775             | ...                              | ...        | 4.6  | 6.2  | 9.0   | 13.7  |
| 800             | ...                              | ...        | 3.5  | 4.8  | 7.0   | 10.5  |
| 816             | ...                              | ...        | 2.8  | 3.8  | 5.9   | 8.6   |

## NOTES:

- (1) Ratings for Class 75 terminate at 350°C.  
(2) Ratings for Class 150 terminate at 538°C.

**Table A-2 Rating Ceiling Values in psig**

| Temperature, °F | Ceiling Pressure by Classes, psig |            |     |       |       |       |
|-----------------|-----------------------------------|------------|-----|-------|-------|-------|
|                 | 75                                | 150        | 300 | 400   | 600   | 900   |
| -20 to 100      | 145                               | 290        | 750 | 1,000 | 1,500 | 2,250 |
| 200             | 130                               | 260        | 750 | 1,000 | 1,500 | 2,250 |
| 300             | 115                               | 230        | 730 | 970   | 1,455 | 2,185 |
| 400             | 100                               | 200        | 705 | 940   | 1,410 | 2,115 |
| 500             | 85                                | 170        | 665 | 885   | 1,330 | 1,995 |
| 600             | 70                                | 140        | 605 | 805   | 1,210 | 1,815 |
| 650             | 60                                | 125        | 590 | 785   | 1,175 | 1,765 |
| 700             | [Note (1)]                        | 110        | 570 | 755   | 1,135 | 1,705 |
| 750             | ...                               | 95         | 530 | 710   | 1,065 | 1,595 |
| 800             | ...                               | 80         | 510 | 675   | 1,015 | 1,525 |
| 850             | ...                               | 65         | 485 | 650   | 975   | 1,460 |
| 900             | ...                               | 50         | 450 | 600   | 900   | 1,350 |
| 950             | ...                               | 35         | 385 | 515   | 775   | 1,160 |
| 1,000           | ...                               | 20         | 365 | 485   | 725   | 1,090 |
| 1,050           | ...                               | [Note (2)] | 360 | 480   | 720   | 1,080 |
| 1,100           | ...                               | ...        | 325 | 430   | 645   | 965   |
| 1,150           | ...                               | ...        | 275 | 365   | 550   | 825   |
| 1,200           | ...                               | ...        | 205 | 275   | 410   | 620   |
| 1,250           | ...                               | ...        | 180 | 245   | 365   | 545   |
| 1,300           | ...                               | ...        | 140 | 185   | 275   | 410   |
| 1,350           | ...                               | ...        | 105 | 140   | 205   | 310   |
| 1,400           | ...                               | ...        | 75  | 100   | 150   | 225   |
| 1,450           | ...                               | ...        | 60  | 80    | 115   | 175   |
| 1,500           | ...                               | ...        | 40  | 55    | 85    | 125   |

## NOTES:

- (1) Ratings for Class 75 terminate at 650°F.  
(2) Ratings for Class 150 terminate at 1,000°F.

## NONMANDATORY APPENDIX B GASKETS (OTHER THAN RING-JOINT)

### B-1 GASKET MATERIALS AND CONSTRUCTION











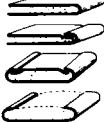


Classification of gasket materials and types is shown in [Table B-1](#). Other gaskets that result in no increase in bolt loads or flange moment over those resulting from the gaskets included in the respective groups may be used. See [para. 5.4](#).

### B-2 GASKET DIMENSIONS

Reference to a dimensional standard for gaskets, such as ASME B16.21, is recommended. In any case, selected dimensions should be based on the type of gasket and

its characteristics. These characteristics include density, flexibility, compatibility with the fluid being contained, and gasket compression needed to maintain sealing. Consideration should be given to the need for a “pocket” at the gasket inside diameter (between the flange facings) or of intrusion of the gasket into the flange bore. Consideration should also be given to the effects that the contained fluid may have upon the gasket, including damage that may result from partial disintegration of the gasket material.

**Table B-1 Gasket Groups and Typical Materials**

| Gasket Group Number | Gasket Material  | Sketches  |
|---------------------|--|---|
| Ia                  | Self-energizing types:<br>O-rings, metallic, elastomer, other gasket types considered as self-sealing                              | ...   |
|                     | Elastomer without fabric   |    |
|                     | Compressed sheet suitable for the operating conditions   |    |
|                     | Fluoropolymer, elastomer with cotton fabric insertion  |    |
|                     | Elastomer with or without wire reinforcement   |    |
|                     | Vegetable fiber  |    |
| Ib                  | Spiral-wound metal, with nonmetallic filler  |    |
|                     | Corrugated aluminum, copper or copper alloy or corrugated aluminum, copper or copper alloy double jacketed with nonmetallic filler |    |
|                     | Corrugated aluminum, copper, or brass  |    |
| IIa and IIb         | Corrugated metal or corrugated metal double jacketed with nonmetallic filler   |   |
|                     | Corrugated metal   |  |
|                     | Flat metal jacketed with nonmetallic filler  |  |
|                     | Grooved metal  |  |
| IIIa and IIIb       | Solid flat metal   |  |
|                     | Ring-joint   | ...   |

(17)

## NONMANDATORY APPENDIX C QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.<sup>1</sup> A determination of the need for registration and/or certification of the product manufacturer's quality system program by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demon-

strating program compliance shall be available to the purchaser at the manufacturer's facility. A written summary description of the program utilized by the product manufacturer shall be available to the purchaser upon request. The product manufacturer is defined as the entity whose name or trademark appears on the product in accordance with the marking or identification requirements of this Standard.

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<sup>1</sup> The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality (ASQ) as American National Standards that are identified by the prefix "Q," replacing the prefix "ISO." Each standard of the series is listed under References in [Mandatory Appendix II](#).

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